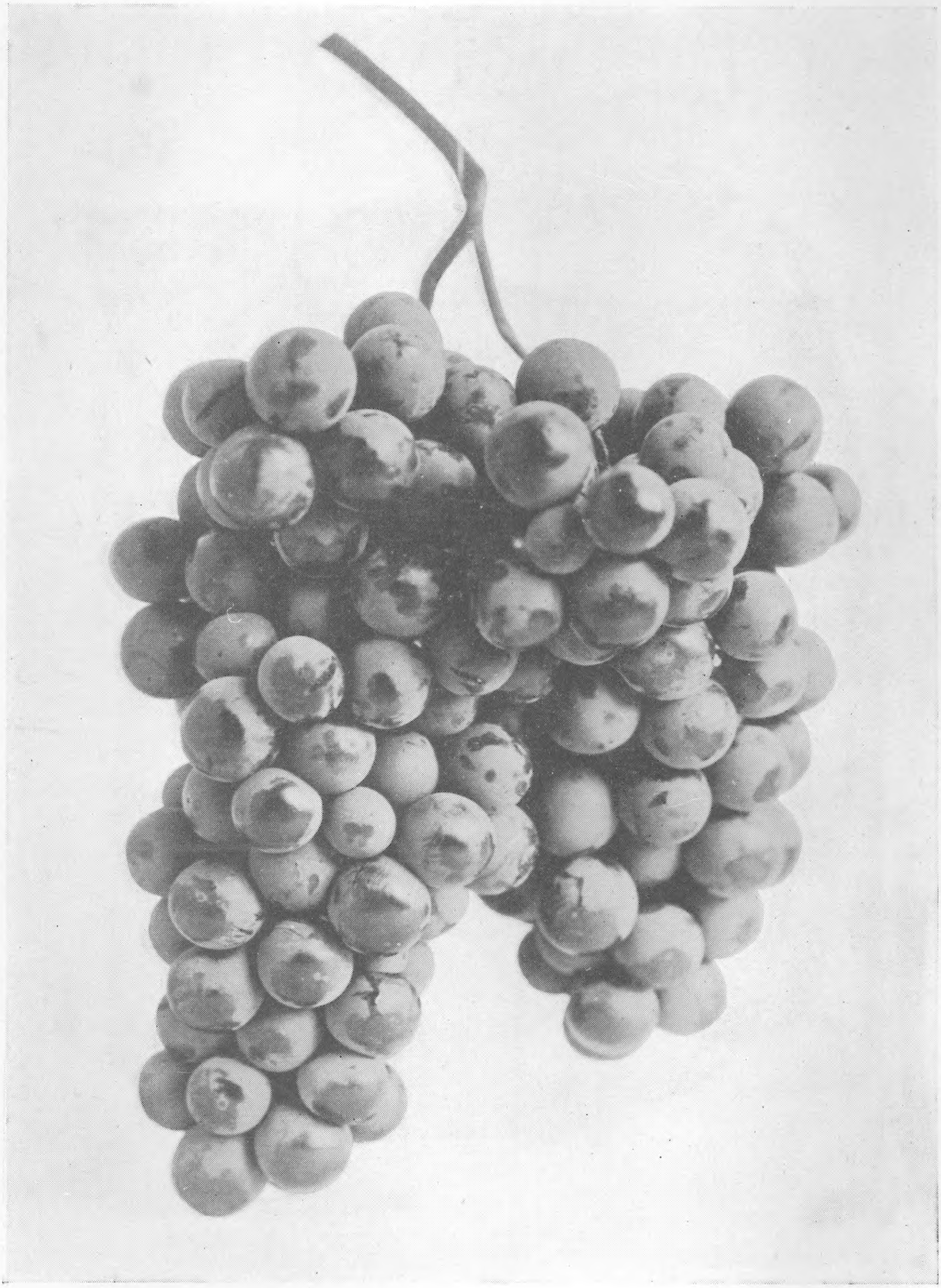
The

Encyclopedia of Practical Horticulture



Roumania.

—*Maxted Photo*

The

Encyclopedia of Practical Horticulture

A Reference System of Commercial Horticulture

Covering the Practical and Scientific
Phases of Horticulture with Special
Reference to Fruits and Vegetables

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Assisted by the best known scientific and practical horticulturists
throughout the country, and particularly in the Northwest . . .

Illustrated

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Bush Fruits

After the selection of a proper site for the growing of bush fruits, the most important factor entering into it, is the man. This has been demonstrated so often, and in so many parts of the country, one man succeeding where another fails, that it needs no extended proofs here. We will refer to our article on apples as an illustration showing how by the choice of good varieties, and by the proper care in packing and marketing, one man will make a good profit, while another will barely live. Card in his book on "Bush Fruits," says: "The yield of black raspberries for a given year, as reported by 58 growers ranged from 567 quarts per acre to 9,600 quarts per acre." Just how much of this difference was due to unavoidable conditions, and how much to preventable circumstances, is not known; but our observation leads to the conclusion, that much, very much, depends on the man. "The yield of blackberries per acre as reported by 50 growers, ranged from 1,280 quarts, to 10,000 quarts. The average was 3,158 quarts per acre." The highest yield shows the possibilities of high productions under favorable conditions, the low yield shows what to expect under poor conditions with poor management.

It is conceded that all the bush fruits, except perhaps cranberries, do better in a deep rich soil, well drained, than under other conditions. Perhaps in no section of the United States do berries produce larger returns than in the Pacific coast region. Here, nature seems to have furnished the conditions of soil and climate best adapted to this kind of fruit.

In the Rocky mountain and Alleghany mountain regions it is conceded that a rich loam, with a clay subsoil, is better for most varieties, while for some, a sandy loam is best. Generally, a good corn and potato soil, is good for small fruits. However, for certain kinds of fruits, especially raspberries, a north slope is better than a south slope because they reach a higher development, where the sun is not too hot. A considerable degree of humidity in the atmosphere is also favorable.

The roots of small fruits do not extend so deeply into the ground as the roots of the larger trees like apples and pears, therefore require more moisture near the surface of the soil, and are more quickly affected by drouth.

Fertilizers

It is impossible to tell, without knowing the character of the soil, what fertilizers should be used. Some soils are full of humus, and to add fertilizers of that character would be superfluous. Generally, where there is an abundance of humus, there is a lack of some of the mineral elements necessary to a good crop. Other soils lack humus, because they are located in the arid or semi-arid regions, where vegetation has grown but little. These soils are generally rich in mineral elements, because the soils have not been leached by rains and floods. Some soils are disintegrated lime stone, and to add lime might injure them, while others are disintegrated sand stone or basalt. A soil analysis is necessary in order to know intelligently what to add and what fruits are best adapted to certain conditions.

Selection of Varieties

There are several considerations which should determine the varieties of any particular species of fruit that should be grown.

First. Selection in reference to soil adaptations. Certain varieties of fruits have become adapted to certain conditions. These conditions must be observed if the best results are to be reached. There are varieties better suited to sandy soils, others to clay, others to black loam, and a study of the nature and habits of the species, or variety of the species, before planting, may obviate much disappointment.

Second. Selection of varieties in reference to climate. The U. S. Pomological Society divides the United States and Canada into districts and gives a table of fruits recommended for each district. These recommendations have been made with a good deal of care, and while they might be amended by the State Experiment Station, or by the experience of growers in any particular locality, they nevertheless have much merit, and it would hardly be considered prudent for the amateur fruit grower, to select his varieties, without consulting their tables.

Third. Selection of varieties with reference to altitude. There are places in the United States where 100 feet in altitude will make as much difference in the temperature as 100 miles further north.

Fourth. Selection with reference to frost.

There are three conditions that tend to protect from frost. The first is altitude, or elevation above the surrounding country. This does not mean, necessarily a high altitude; but it means that in relation to the lands around it, there are lower lands, toward which the cold air will gravitate.

The second influence affecting frost conditions is evaporation from large bodies of water. A body of water radiates heat less rapidly than the earth's surface. Therefore, in the autumn, the earth cools faster than the water. When the prevailing winds come from a large body of water as a sea, or lake, the atmosphere in the autumn is warmer from the water surface, thus preventing early autumn frosts. In the spring time, the earth absorbs heat faster than the water surface, thus the breezes coming from the body of water are cooler, and the budding of fruit is delayed beyond the frost period. Examples of this are seen on the Pacific coast, Michigan bordering on the lake, and other portions of country similarly situated.

The third influence affecting frost is air drainage.

To have good air drainage a tract should be so situated that there are no obstructions to the free passage of the cold air downward. A pocket will be frosty. Wherever the air tends to stagnate there will be a tendency to frost. Locations in gaps, gorges or canyons opening out into valleys or broader spaces afford good drainage as there is usually a movement of air forced by the pressure from the higher lands and the broad opening permits a free escape. This circulation of air tends to prevent the frost from forming.

Fifth. Location with reference to markets.

It makes a great deal of difference, in handling tender and perishable fruits, whether they are hauled or shipped long or short distances. A long haul, over the ordinary country roads, often bruises and injures the fruits, so that when they reach the local market, they are unsaleable. A long distance shipment takes time, and in that time, the fruits are more or less damaged. Besides the extra expense of a long shipment there are dangers of delays, wrecks and other losses, that often cause trouble. Other things being equal, it is much better to have an orchard near the markets.

For the different varieties of bush fruits treated, see under their respective names:

Blackberry, currant, gooseberry, huckleberry, raspberry.

GRANVILLE LOWTHER

By-Products of the Apple

The utilization of cull and possible surplus apples is a matter of economic importance, and may, in many instances, mean a difference between profit and loss in the apple business. Just as the great packing concerns utilize every particle of their raw material and allow nothing to waste, so can the grower utilize his cull apples in many ways and check or prevent waste. There is a special use for every part of the apple. Seeds are used by large nurserymen for growing apple seedlings. The skin and core are preferred by the jelly makers on account of high sugar content and the coloring matter of the skin. The pulp or flesh is used for canning, evaporating, apple butter, apple paste and other products But the greatest value is in the juice.

The maker of juice products strives first of all to get the greatest possible amount of juice from his apples. The amount of juice that the apples contain depends upon the condition of ripeness, as well as upon the variety. An over ripe apple is mealy and contains less juice than one in prime condition. Also certain varieties such as Jonathan and Winesap contain more juice than certain other varieties, such as Maiden Blush and Rome Beauty. A bushel of good cider apples in prime condition should contain from four to five gallons of juice. The amount of juice that is actually taken out depends largely upon the efficiency of the machinery. The large hydraulic presses with a pressure of from three to five hundred tons seldom get more than four gallons to the bushel, while the small hand presses seldom get more than two and one half gallons to the bushel. Just as the last strippings of a cow's milk is the richest part of her milk, so the juice that is left in the pomace after the first pressing is the richest of the juice. In fact after the first pressing by the best presses it is figured that from 25 to 40 per cent of the sugar content still remains in the pomace. We shall see as we proceed that the sugar content largely determines the quality of the juice, for most of the products made therefrom. The pomace therefore, is very often soaked up and repressed.

The products of apple juice may be discussed under three main divisions as follows: Plain apple juice or sweet cider, reduced apple juice, and products of fermentation.

Sweet Cider

It would seem that the simplest marketable product of apple juice is sweet cider, which is the juice just as it comes from the press. It is a simple matter to make sweet cider, and it is a marketable product for which there is a good demand. But it is not such a simple matter to keep cider sweet, without in some way impairing its quality. In fact this difficulty of properly preserving sweet cider has undoubtedly been the greatest barrier to the proper development of the sweet cider business, and likewise the greatest barrier to satisfying the demands of a sweet cider loving public.

Difficulty of Keeping Cider Sweet

In order to understand something of the cause of the difficulty of keeping cider sweet, it is necessary for us to know something of the composition of apple juice, the processes of fermentation and the organisms which cause fermentation. This will be explained more fully in discussing the products of fermentation. It is only necessary here to explain that certain minute organisms enter the juice immediately upon its being exposed to the atmosphere. Under ordinary conditions these organisms develop and multiply rapidly and in doing so transform the sugar of the juice into alcohol. When the formation of alcohol has begun still other organisms enter and change the alcohol into acetic acid. It can be readily seen then that the problem which the sweet cider man has to solve is the controlling or stopping of the work of these organisms.

The general practice for many years has been the use of such chemical preservatives as benzoate of soda, boric acid and salicilic acid. Benzoate of soda is undoubtedly the preservative that is in most general use, and probably the one that gives best results, so far as chemicals

are concerned. But even benzoate of soda comes far from giving entire satisfaction. Its use impairs the quality of the juice and does not completely prevent fermentation. Its use is limited by the pure food laws to 1/10 of 1 per cent.

Recent investigations by the United States Department of Agriculture have proven the feasibility of other and better methods of preserving sweet cider. The first of these is the cold storage method. It is well known that these ferment organisms do not thrive at a low temperature. Under this method the cider is taken immediately from the press and cooled rapidly to 32 degrees Fahrenheit, and is then held in storage at that temperature. In the Government tests* the juice was held in this way for from 36 to 70 days without noticeable fermentation and was held for from 90 days to 125 days before being considered "hard" or "sour."

Another method tried out by the Government and which bids fair to come into general use is that of sterilization or pasteurization. By pasteurization we mean heating the juice to a temperature that will kill any of the ferment organisms which may be present. * It was found that to slowly heat the juice to the required temperature gave it a decidedly cooked taste. But a Pasteurizer was devised by which the desired temperature was obtained very quickly, under which condition the cooked flavor is scarcely noticeable.

The Pasteurizer used for this purpose consists of a steam box in which is a coil of pipe. The juice is passed through this coil and can be taken out at any desired temperature, depending upon the rate of flow. It is heated up to 170 degrees Fahrenheit and put at once into sterilized containers, care being taken to avoid any possibility of contamination. It must be remembered that hot juice put into a barrel or other container will shrink upon cooling and thus leave a space at the top of the container. For this reason the containers are not bunged tightly until the juice has cooled. A small hole is bored in the bung. This hole is stuffed with cotton which has been previously soaked in alcohol, so that the air that passes through the cotton is sterilized. When the juice has cooled a wooden skewer which has first been sterilized is driven into the hole and sawed off on top.

Cider preserved in this way should remain sound and sweet indefinitely. In the experiments carried on by the Government the cider was perfectly sound and sweet at the end of six months.

Apple juice may be put upon the market in reduced forms. Cider boiled down to one-fifth of its original bulk has almost the density of syrup. This product is used in making pies, sauces, apple butter and in other cooking. It finds ready sale at good prices in the Eastern markets.

Apple juice reduced to one-seventh or one-eighth its original bulk becomes jelly. Special apparatus for reducing apple juice rapidly is to be had on the open market.

We are now ready to discuss some of the ferments and the products of fermentation. It has been said above that when apple juice is exposed to the air in a moderate temperature fermentation begins almost immediately. Fermentation starts in because certain minute yeast cells which are nearly everywhere have entered the juice and have found an ideal place for their development and multiplication. On this development and multiplication they are doing certain work. They are changing the sugar of the juice into carbon dioxide and alcohol remains in the juice. After fermentation has started but is not yet complete we have what we call "hard cider." By the term "dry cider," or "apple wine," we mean cider that has completed the alcoholic ferment, or, in other words, cider in which all the sugar has been turned into alcohol.

But cider or wine making is not such a simple matter as it might appear. As soon as the alcoholic ferment has begun,

*Ref. Cir. No. 48, Bureau of Chemistry, U. S. Department of Agriculture.
*Note, Bul. No. 118, Bureau of Chemistry, U. S. Department of Agriculture.

if the juice is still exposed to the atmosphere, other ferments which are injurious or destructive to the making of good wine are bound to enter. The thing of primary importance to the cider or wine maker then is avoiding contamination of his liquor.

The juice as it comes from the press is put at once into barrels which have been thoroughly steamed or scalded. The barrel is filled only about three-quarters full to avoid overflowing during the period of tumultuous fermentation.

When the juice has been put into the barrel a fermentation funnel is immediately put into the bung and tightly sealed around the edge of the bunghole with paraffine or vaseline. A fermentation funnel is so arranged that the gases from within the barrel escape, but the air from without cannot enter.

In recent years some of the ferment yeasts have been separated into many varieties and pure cultures made of these varieties. It has been found that fermentation may be hastened by the use of certain pure culture yeasts, and also that the flavor of the wine depends largely upon the variety of yeast used.

After fermentation has been completed the cider is drawn off from the top into freshly sterilized containers, leaving the lees and sediment in the bottom of the old containers. The new containers are tightly bunged and sealed and stored in the cellar ready for use.

Perhaps the product of apple juice which is most extensively made in this country at the present time is vinegar. In the manufacture of vinegar, as in the apple industry itself, quality is of first importance. The element of quality in vinegar is largely determined by the per cent of acetic acid. The law in most states requires vinegar to test from four to four and one-half per cent acetic acid. Much of the vinegar made on the farms, in a haphazard way, not only will not stand this test but, on account of decomposition or other cause, is unfit for use, and does not find a ready market. On the other hand a recent writer on the subject says:

"Apple cider vinegar is demanded by the trade. There is not one-tenth enough pure cider vinegar made in this country today to supply the ever-increasing demand."

To make a good product the vinegar maker must first have pure apple juice which must test not less than nine per cent sugar; 10 per cent to 12 per cent is much better. It is upon this sugar content of the juice and its subsequent chemical changes from sugar to alcohol and from alcohol to acetic acid that the manufacture of vinegar depends.

(1) Sugar = Alcohol + Carbon Dioxide
$C^6H^{12}O^6 = 2C^2H^6O^2 + 2CO^2$

(2) Alcohol + Oxygen = Acetic Acid + Water
$C^2H^6O + O = C^2H^4O^2 + H^2O$

Theoretically, to get a four per cent acid vinegar requires a cider containing four per cent alcohol. And to get a cider containing four per cent alcohol we must have a juice containing eight per cent sugar. In practice it is best to leave a little margin above these figures to allow for incomplete chemical change or waste.

The vinegar maker therefore strives to get a juice as rich as possible in sugar content. The sugar content of the juice depends upon the conditions of ripeness of the apples as well as upon the variety. While an apple that is underripe has not yet changed its starch to sugar, an apple that is overripe has in some peculiar manner lost some of its saccharine substance. An apple must therefore be in prime condition of ripeness to show highest sugar content of juice.

Many tests of varieties have been made, and published lists of the sugar content of different varieties are to be had. It is a simple matter for anyone to make this test with a saccharometer. In practice, however, the vinegar maker seldom has the chance to select his varieties, but must take a mixture of the varieties as they run. It is enough here to say that the average mixture of varieties, if in good condition, will test sufficiently high, and that our favored winesaps and Jonathans are both high-testing varieties.

The minute organisms that are responsible for changing the sugar content of apple juice to the acetic acid of vinegar require special conditions in order to thrive and do their work. The practice of modern vinegar making has been greatly facilitated by a knowledge of the habits and requirements of these organisms, and a proper manipulation of the juice to fill these requirements. The yeast plant, which, as has been stated above, is responsible for the alcoholic ferment, thrives best in a temperature of 75 degrees to 85 degrees Fahrenheit. If the storage room be kept at this temperature the alcoholic ferment should be completed in about four weeks. Special yeast cultures are sometimes used to hasten the process.

The acetic ferment, or the bacteria, that are responsible for the chemical change of alcohol to acetic acid require oxygen in order to thrive and to do their work, and the cider must therefore come in contact with the atmosphere. Since only the surface of the cider in a barrel comes in contact with the air it is only upon the surface that the acetic ferment works. For this reason the old system of allowing the cider to stand in barrels until it becomes vinegar requires a period of many months, usually about two years.

The modern vinegar maker hastens matters by passing his cider through a "generator." A "generator" is a tall tank having a perforated false bottom some eight to ten inches from the real bottom, and a false head a few inches from the top of the staves. The space between the false bottom and the false head is filled with rattan or beachwood shavings, or some other suitable material. Just above the false head the cider is fed into a little trough, which automatically dumps and spreads the cider over the perforated head. This allows it to trickle down through the shavings, thus exposing every drop to the air. In this way the same process which requires two years in the barrels is accomplished in a single day. However, for the average orchard man the old barrel process is still probably the most practical. Even this process may be very much shortened by a proper manipulation of the cider in the barrels. It may be racked off into new barrels frequently and in that way thoroughly stirred and exposed to the oxygen of the atmosphere.

The ideal temperature for the acetic ferment is about 86 degrees Fahrenheit. That is the bacteria is most active at this temperature and becomes less active as it varies either way from this. At 104 degrees Fahrenheit their action ceases entirely.

Upon completion of the vinegar process the vinegar maker takes every precaution to check further chemical change or decomposition. He puts the finished product in pure, clean, barrels carefully guarding against the presence of vinegar eels or other foreign matter. The barrels are then tightly bunged and his product is ready for the market.

P. S. Darlington,
District Horticultural Inspector.

Cabbages

The parent from which the variety of cabbages in common use has sprung is supposed to be the wild sea cabbage *(Brassica oleracea)*, a plant found near the seacoast of various parts of England and continental Europe. The cultivated varieties vary greatly from the original type, but present striking similarities amongst themselves. There are some points however, in which the wild and the cultivated are nearly alike and these are in the flower seed pod and seed.

Cabbages contain a very small per cent of nitrogenous compounds as compared with most articles of food. An analysis when cooked will show that they generally contain chemical constituents as follows: Water, 97.4 per cent; fat, 0.1 per cent; carbohydrate, 0.4 per cent; mineral matter, 0.1 per cent; nitrogenous matter, 0.6 per cent; cellulose, 1.3 per cent. They are said to possess anti-scorbutic properties. Apart from that, the analysis shows that they have very little food value.

The Soil

Cabbages require a deep rich soil, where they can be made to grow rapidly

and be crisp and tender. Almost any good soil that will grow corn, vegetables and other crops successfully will grow cabbages; but with some vegetables it is possible to get the soil too rich while with cabbages there is little danger. The Pacific Northwest is well adapted to the growing of cabbages, and in the low lands of the eastern side of the Cascade mountains, where irrigation is practiced and the alkali is strong, excellent cabbages can be grown on land too strong in alkali for fruit trees. However, it must not be supposed that all alkali soils would be good for cabbages; for we have seen the alkali so strong that nothing would grow. We only wish to suggest that land sometimes considered waste, because it will not successfully grow fruit trees or hay, may be utilized for cabbages.

For an early crop the seed should be sown in hotbeds, early in the spring, and the plants set in rows in the field or garden as soon as the danger of frost is over. The plants are not tender, and will stand considerable cold, so that it is not necessary to exercise the same care as in case of beans, tomatoes, or some other garden plants. For a late crop the seed may be planted in the open, and the plants set almost any time during the summer. It is not uncommon, in the milder climates, to set the plants as late as September, and allow them to stand in the field as late as December. This method is practiced by many growers, in order to avoid the pests that are much more destructive during the summer than in the autumn.

Setting the Plants

The plants should be set in rows, about three feet apart, so that it is easy to cultivate between them. Some practice the method of cross cultivation, in which case the plants have to be set in squares about three feet each way, and the rows both longitudinal and transverse. Plants should be set in the evening, and the ground about them well watered, so as to keep the roots wet and the plant sappy during the next day, until the little tender root hairs begin their work of supply. If plants are not set during the evening, then they should be covered with a leaf, or paper, or something to protect them from the sun. The stem of the plant should be set deeply enough so that the leaves are within an inch or so from the surface of the ground. It is better to set the stem in the earth up to the leaves than to leave too much of it exposed, as is often done.

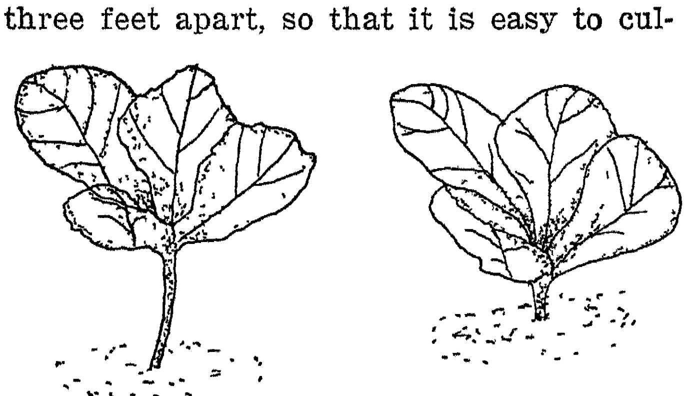

Fig. 1. The Plant on the Left Is Set Too Shallow. The stem is exposed to the sun and freezes. The plant on the right is set the proper depth in the soil.

Varieties

Recommended for the Inland Empire section of Oregon, Washington and Idaho.

Extra Early Express (Burpee), Early Jersey Wakefield (Burpee), Early Winigstadt (Burpee), Surehead (Burpee), American Drumhead Savoy (Henderson).

On the question of varieties for the South we quote from C. C. Newman, South Carolina Agricultural College.

"Contrary to the general opinion, the early maturing varieties are better suited for winter use in the South than the late varieties. If the late varieties are planted at the usual time in the spring, they will mature before fall, and if planted in late summer, they will not mature until midwinter, and are liable to be seriously injured before they are ready to be harvested. In the mountain section where the summers are not too severe, the late varieties, set out in May and June, mature during the months of October and November.

"We have tested practically all the varieties of cabbages in our trial grounds for the last five years, and the Charleston Wakefield, Early Summer Succession, and Late Flat Dutch, have given best results for fall and winter use, when planted to the field the first week in August. There are, of course, a large number of varieties that will produce fine fall cabbages, but

the three mentioned seem to be about the best for this section of the country. The two first named varieties will mature during October and November, and the Succession will form large solid heads by the middle of December. The late Drumhead Savoy will probably endure more cold after heading than any of the smooth leafed varieties, and is, therefore, very desirable for a very late winter cabbage. It is highly recommended for home use and for local markets. Late Flat Dutch is an excellent variety to follow Succession. Cabbage here will endure a temperature of 26 degrees without injury.

"Cabbage seed sown in an unprotected bed about October 1st will produce nice, stocky plants for transplanting to the field in early spring. Seed sown at this time will make short, stocky plants, which will head from May to July, according to the earliness of the variety. Seed sown in the open ground about the first of September will usually make too much growth before cold weather, and are liable to run to seed when transplanted in the spring, without forming heads. Seed sown in protected frames early in January will be ready for transplanting to the field early in March. Before transplanting, these plants should be gradually hardened off by exposing them to the cool weather and allowing the bed to become moderately dry. Cabbage plants set to the field in October will not be injured to any great extent, even during the coldest weather. The plants will make considerable growth during October and November, but from the last of December to the last of February little growth will take place. After the first of March the plants begin to grow more rapidly, and by the first of April they will begin to form heads. When the plants are set out too early in the fall, they will form small heads by the middle of December, and a large per cent of the plants will run to seed in the spring, without forming marketable heads.

"The following table gives some idea as to what might be expected from an acre of fall cabbages:

Year 1908

Variety	Seed Planted	Plants set to field	Per cent. of plants died	When matured	Average Weight	Per cent. of plants that headed	Yield per acre
Charleston Wakefield	June 3d	Aug. 15	5%	Nov. 1 to Dec. 5	3 lbs.	95%	12,630 lbs.
Henderson's Success'n	June 3d	Aug. 15	6%	Nov. 10 to Jan. 1	6¼ lbs.	92%	23,490 lbs.
Late Flat Dutch.....	June 3d	Aug. 15	8%	Nov. 25 to Jan. 15	6 lbs.	85%	18,480 lbs.

"The soil on which these cabbages were grown would produce about 40 bushels corn per acre.

"Ten two-horse loads of stable manure was applied broadcast per acre, and the soil was then plowed eight inches deep with a two-horse turn plow. One thousand pounds of fertilizer, analyzing eight per cent phosphorous acid, four per cent nitrogen, and seven per cent potash, was then applied broadcast, and mixed with the soil with an Acme harrow."

Harvesting the Crop

When mature, if cabbages are grown for the markets, they are generally pulled, some of the outer leaves taken off, the stems cut off, and they are then crated for shipment. If they are grown for home use, they are treated in like manner and stored in a cool place, the nearer to the freezing point the better. Sometimes the farmer pulls his cabbage late in the autumn or early in the winter, and places them in trenches with the stems

Fig. 2. Two Heads of Succession Cabbage Cut From the Field After Having Withstood a Temperature of 20 Degrees.

upward, throwing a little dirt over them and taking them out as they are needed for use. When the winters are mild, we have known cabbages left in the field all winter to be in fairly good condition the following spring. GRANVILLE LOWTHER

Wide Variation in Price of Cabbage

Of the 40 different agricultural products, the prices of which are obtained monthly by the department of agriculture, cabbage varies most widely in price. For the entire United States the average price paid to producers on January 15 was about $1.26 per 100 pounds. This average is based upon reports of correspondents from 778 towns, representing every state of the Union. The lowest average for any state is 24 cents per 100 pounds for New York. The highest average is $3.33 per 100 pounds for Alabama. The average of 24 cents per 100 pounds in New York is based upon reports from 23 towns, eight of which returned 15 cents per 100 as the average; no quotation was above 50 cents per 100 pounds. In the adjoining state, Pennsylvania, the average price was about $1.60 per 100 pounds, not one of the 23 reports received being under $1 per 100 pounds. Here is an average difference of $1.36 per 100 pounds in the average price paid to producers of cabbage in two adjoining states.

Crop Reporter, January 1, 1913.

CABBAGE METHODS OF PROPAGATION IN ALASKA. See *Alaska*.

For PROPAGATION IN THE GULF STATES see *Alabama*.

CABBAGE DISEASES

Black Leg or Phoma Wilt

Phoma oleracea

F. D. BAILEY

This is a serious disease of cabbage and cauliflower. Though it has only recently been reported in the United States, it has already become widely distributed. In Ohio many fields have been seriously damaged, in some, indeed, the disease was so severe that no marketable cabbage were cut. It is supposed that this disease was introduced from Europe where it has caused severe losses, especially in France, Germany and Holland. It has been known in Australia for a number of years and is thought to be the most serious disease affecting cauliflower and cabbage in that country. This disease has been found in Oregon, during the season of 1912, in Jackson and Wallowa counties. In the latter, where it probably appeared the previous year, it is already causing alarm. It is very probable that the fungus may be introduced on seed, and it is interesting and possibly significant to note that the Wallowa grower purchased his seed from Illinois the year he first observed the disease.

Symptoms

The most characteristic symptom of this disease is the blackening and decay of the stem close to the surface of the ground. (Fig. 1.) Cankered areas are produced which sometimes completely girdle the stem and the plant is often broken over by the wind. The outer leaves of affected plants are bluish red in color, a characteristic which remains until the plant dies. Plants may be attacked at any time in their growth, more often, however, when they are about one-half grown.

Other symptoms are spots on stem and leaves, in which numerous very small black specks can be seen. A wilting, in which the leaves droop instead of falling off, is frequently observed in diseased plants.

Cause

The fungus which causes black leg of cabbage and cauliflower is known technically as *Phoma oleracea.* It enters the plant at some place near the surface of the ground, probably in wounds made by insects. Leaf infection may also take place. From these infected spots the fungus spreads, killing the plant tissues and shutting off the food supply from other parts. It comes to the surface to form the pycnidia or small black specks in which great numbers of minute spores are produced. These spores are forced to the surface and are carried by wind, water, insects or other agencies, to start new infection. Many seedlings are infected at planting time. If an occasional diseased seedling is handled, spores will be transmitted to the hands and later to healthy plants. The disease is frequently found closely associated with the wounds and injuries of insects, though infection may take place without aid from this source.

Fig. 1. Black Leg of Cabbage. The stem is often girdled near the surface of the ground.

Treatment

The black leg organism is doubtless carried over in the stems and leaves of old decaying plants. It is a fungus capable of living in the soil, but one that can be controlled if the proper measures are constantly employed. The greatest care should be taken to keep the seed bed free from it, thus making certain that it does not become distributed over the fields. The recommendation is made in Ohio that the seed beds be sprinkled with 4-4-50 Bordeaux at the time of planting, using one gallon of the mixture to each 10 square feet. This operation should be repeated two weeks before transplanting and again just before transplanting. This method has proven effective in holding the disease in check. It is better to select clean ground for the seed bed each year and disinfect the seed to be used. A safe treatment for cabbage and cauliflower seed is to use a solution of formalin, one-fourth pint in seven gallons of water, allow them to soak for 15 minutes, rinse in clean water and spread out to dry.

When the disease appears in the field the affected plants should be removed and burned.

The truck growers of the Northwest may well be on the lookout for this dis-

ease. It must be dealt with intelligently from the first, for, once established, the disease is a difficult one to control.

Brown or Black Rot

Bacterium campestre (Pam) Erw. Sm.

Is a serious disease of these two crucifers, and attacks others of the family, including turnips. It is a veritable scourge to the cabbage growers of Ohio and other states. Smith (Farmers' Bul. 68, U. S. D. A.) has published concerning it and has attributed the disease to a specific germ. The diseased heads may be dwarfed, in portions rotted, and brown colors will appear in the woody layers of the plant, including the stem. Badly diseased heads emit a penetrating and offensive odor. The losses from the brown rot have been very large and specific remedies cannot be stated. The author quoted sums up the subject of treatment in one word—prevention. The measures recommended are—plant on new land and only from healthy seed beds; avoid succession of the same crops; avoid stable manure and give preference to artificial fertilizers to escape possible infection through the manure. Prevent animals from cropping in diseased fields. Clean tools by scouring bright after use in infected soil. Fight the cabbage insects, since these inoculate healthy plants with the disease. Removal of badly affected plants, or newly infected leaves, at intervals, and subsequent burning or deep pitting of this refuse may aid in checking brown rot. Destroy all mustard weeds.

The water pores of the cabbage are large, as is evidenced by the great amount of water which collects on the outside of the leaves under certain conditions, which makes the cabbage quite susceptible to this form of disease.

A. D. Selby,
Wooster, Ohio.

Club Root

Plasmodiophora brassicae

F. D. Bailey

This is a destructive root disease of crucifers attacking, among the cultivated crops, the cabbage, cauliflower, turnip, etc. It is caused by a very minute organism belonging to the group Myxomycetes, commonly referred to as the slime moulds. The technical name of the organism causing this disease is *Plasmodiophora brassicae.* This disease occurs in various sections of the Northwest, but cannot be considered to be a very common trouble. The knotty swellings or club-shaped enlargements (Fig. 1) resulting from the invasion of roots by this fungus prevent the normal growth of head or root and gradually kill the plant.

Fig. 1. Cabbage Plant Affected With Club Root.

When once established in the soil, the fungus will live for several years. Certain weeds, shepherd's purse and hedge mustard, are good hosts and doubtless furnish opportunity for the disease to perpetuate itself and to spread.

Control

Care must be taken to keep the seed beds clean. Destroy all refuse from diseased plants. Do not allow such material to get into the compost heap. Practice rotation with crops not included in this group of plants, and keep the weeds down.

Fig. 2. Club Root on Turnip.

Experiments have shown that an application of lime at the rate of about 100 bushels per acre when the land is plowed in the spring is a reliable method of control.

Damping Off

Caused by soil fungi of several varieties. The young plants slough off at the ground. The trouble occurs when they are crowded or conditions are too moist. Surface soil should be given a chance to dry. Mainly a seed bed trouble.

Downy Mildew, Leaf Blight and White Rust

Occur upon plants of the mustard family, including the cabbage.

If treatment seems necessary use Bordeaux mixture.

Fusarium Wilt

This trouble has become very destructive in the cabbage growing sections of the Eastern states and bids fair to rank with black rot in importance. It causes a yellowing and wilting of the plants.

The only remedy suggested is the breeding of resistant stocks.

Root Rot, Stem Rot, Rhizoctonia

Due to the same fungus which attacks the potato. It would seem that general sanitary measures and rotation is the only practicable remedy.

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CABBAGE PESTS

Cabbage Aphis. See *Aphids;* also *Cabbage Louse,* this section.

Cabbage Curculio

Ceutorhynchus rapae, Gyle.

Feeds upon the edge of the leaf. Not serious as yet and not in the Northwest so far as known.

Cabbage Hair Worm

Mermis albicans Deising

Looks like a piece of basting thread. White in color, coiled or coiling and uncoiling or crawling on cabbage heads. From two to nine inches long.

Exaggerated reports of poisonings from the presence of this worm came from the South some years ago.

The worm is entirely harmless.

Reference

Bu. Ento. Circ. No. 62, Revised.

Cabbage Louse

Aphis brassicae Linn.

General Appearance

Dark greenish yellow to brownish, with dark transverse bands across the abdomens of some individuals. All covered with a fine white powder, which gives them a silvery or frosted appearance.

Life History

The lice appear with the first plants in the spring and increase with such rapidity as to soon almost entirely cover the host. This condition prevails throughout the early summer, after which the parasites begin to reduce their numbers. It is a disgusting pest on cabbage, cauliflower and brussels sprouts.

Food Plants

All members of the *Cruciferae* including cabbage, cauliflower, brussels sprouts, mustard, radish, etc.

Natural Enemies

The ladybird beetles, *Hippodamia convergens*, *Megilla maculata* and *Coccinella californica*, prey to some extent upon this pest. The real check, however, is the internal parasite, *Diaeretus californicus* Baker.

E. O. Essig

Cabbage and Radish Maggot

Phorbia brassicae Bauche

A. L. Lovett

This insect is considered a very serious pest throughout the Pacific Northwest, or wherever cabbages and radishes are grown. In the truck crop regions, where these crops are grown over considerable areas and for a period of years on the same soil, the pest is especially serious.

Plants Attacked

Besides attacking the cabbage and radish, this maggot feeds on the turnip, cauliflower, celery, rape, kale, and a variety of the closely allied Cruciferiae. It is also found about the roots of some of the wild plants of this group, including mustard and radish.

Description

The Larva.—It is as a larva that the cabbage maggot is injurious and hence best known to the grower. At this stage it is a footless grub or maggot (see Fig. 1), waxy white or yellowish in color. The

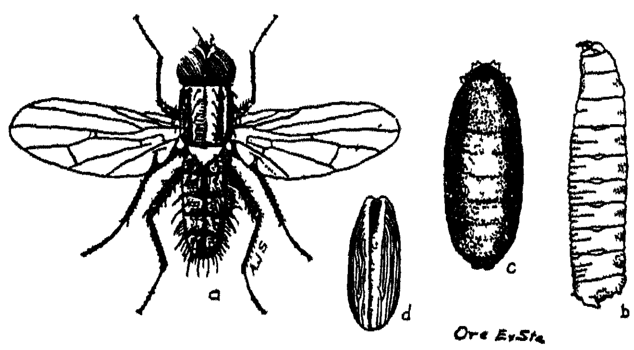

Fig. 1. The Cabbage Maggot (*Phorbia brassicae*), a, adult fly; b, got; c, puparium; d, the egg (much enlarged). (Original)

body is cylindrical, ending bluntly behind and tapering to a point at the cephalic end. When mature, it measures about .32 of an inch in length.

The Pupa.—The pupal or resting stage of the cabbage maggot is passed in the soil about the roots of the infested plant. Exceptions to this rule occur in the forms which assume the aerial habit and in the few which pupate in their burrows in the root. The pupa consists of a small brown case or puparium some two-tenths of an inch in length, elliptical-ovate in form and without the ability to move.

The Adult.—The adult insect varies considerably from the maggot that destroys the plant. It is a fly which appears to the ordinary observer not unlike the common house fly. It is considerably smaller in size, however, and when at rest the wings extend a greater distance back of the abdomen and overlap more.

The Egg is really very small, measuring only .04 of an inch in length. It is white, however, and by the keen observer may be readily seen lying on the soil close to the stem of the host plant.

Life History

This insect passes the winter as larvae and pupae in and about the roots of their hosts. Possibly some of them pass the

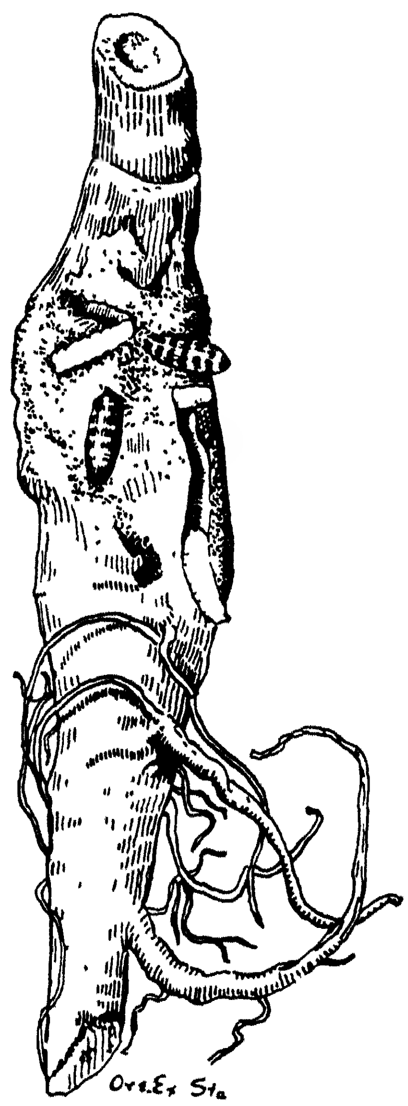

Fig. 2. The Cabbage Maggot. Root of wild mustard showing larvae, pupae and injury.

Fig. 3. The Cabbage Maggot. Radish showing egg.

winter also as adult flies, hibernating in sheltered nooks about the field and in outbuildings. As the warm days of spring advance, the flies emerge from their hibernating quarters and also from the pupal cases in the soil, and seek their host plants for the purpose of egg deposition. The eggs are deposited close about the plant, the female fly working herself down below the surface, if the soil will permit, and placing the egg right against the plant root (see Fig. 3). The eggs are often placed above ground on leaves or developing buds. The eggs hatch in from four to ten days, depending on the temperature, and the young larvae commence at once to burrow into the tender plant (see Fig. 2). The maggots reach maturity in a month to six weeks, pupate and emerge soon after as adult flies. From

Fig. 4. Cabbage Maggot Adult. —*Photo by Essig.*

this time on until late fall one may usually find both larvae and pupae in the soil. As the season advances, a portion of the maggots assume an aerial habit. This is especially true in the fields when early cabbage has been harvested and where the stumps left standing have put out adventitious buds. The flies deposit eggs in these tender buds and the maggots burrow into the midribs of the leaves and into the core of the shoots.

Control Measures

Possibly for no other group of insects will one find such a variety of remedial measures suggested as for the root maggots, nor more diverse results following their application. No single remedial measure will ordinarily afford satisfactory relief. Combinations of preventive and remedial measures are best. A single application of any solution will seldom suffice; hence the crop should be treated again when the effect of the previous treatment is diminished.

Preventives

Plowing of the infested fields as soon as the crop is removed will materially lessen next year's brood. The soil should be turned to a depth of four inches or more.

Destruction of Stumps.—The old stumps in the field or the refuse root crop in the soil should be destroyed. Such materials furnish ideal conditions for the development of this pest.

Rotation of Crops.—Where conditions will permit, rotate the crops so that plants of the family Cruciferae occupy the same soil but a single season. The flies are weak fliers and do not as a usual thing travel far to their hosts.

Screening Seed Beds.—Cabbage plants yet in the seed beds are often infested with this pest, and the maggots are carried with the plants when they are transferred to the field. Mr. Schoene* has studied the value of screening cabbage seed beds and the following discussion is based on his bulletin on this subject. For early settings of cabbage, where the product usually brings a fancy price on

* Schoene, W. J., New York Agricultural Experiment Station, 1911, Bulletin 334.

the market, screening the seed beds pays very well and appears practical, in fact, whenever the crop is valuable. From the fragmentary data at hand, it appears that the period of the seedling growth checks up very closely with the time when the early emerging adults of the cabbage maggot commence their egg deposition.

The usual method is to construct about the bed a frame of six to ten-inch boards placed on edge, well supported and braced, and with cross wires extending over the top to hold up the cloth. Over this frame is stretched cheesecloth, preferably a grade of about 20 threads to the inch. These frames may be used for several years. The following facts are established concerning their use for cabbage seed beds.

1. If the cheesecloth is carefully attached and the frame is tight, injuries by the maggot may be entirely prevented.

2. The work of the flea beetles can be prevented partially or wholly, depending on the grade of cheesecloth employed.

3. The screen conserves the moisture and prevents baking of the soil between seeding time and that period when plants may be cultivated.

4. Plants raised under cloth grow faster during moist seasons and attain the size desirable for transplanting about ten days or two weeks sooner than plants grown in the open.

5. The extra cost of screening plants ranges from six to 20 cents per 1,000. In the opinion of many this cost is met in the first saving of seed.

6. The screened plants are more tender than those not screened, but if the cover is removed a week before transplanting the seedlings will become sufficiently hardened.

The seed bed should by all means be located on a fertile, well drained soil where there can be no accumulation of water or washing under the frames by rain. As it is considerable work to remove the frame to cultivate, see to it that the soil is in good condition and free from weed seed.

Hand Picking.—While a laborious undertaking, is often employed on small fields of cabbage. The plants are simply pulled up, the roots examined carefully for eggs or maggots, and the plant reset. This practice may often be employed to advantage when seedlings are transferred to the field. This method is not practical for radishes or turnips.

The Tarred Felt Discs.—The tarred felt discs are used for the protection of cabbage and cauliflower only, the idea here being to prevent the adult female fly from depositing eggs. No better description of the discs or their use can be given than is found in the original description by W. H. Goff, who perfected this treatment in 1898. The description is transcribed from Circular 63 of the Bureau of Entomology.

The cards are cut in a hexagonal form in order to better economize the material and a thinner grade of tarred paper than the ordinary roofing felt is used, as it is not only cheaper, but being more flexible, the cards made from it are more readily placed about the plant without being torn.

The blade of the tool, which should be made by an expert blacksmith, is formed from a band of steel, bent in the form of a half hexagon, and then taking an acute angle, reaches nearly to the center. The part making the star-shaped cut is formed from a separate piece of steel, so attached to the handle as to make a close joint with the blade. The latter is beveled from the outside all around, so that by removing the part making the star-shaped cut, the edge may be ground on a grindstone. It is important that the angles in the blade be made perfect, and that its outline represents an exact half hexagon.

To use the tool, place the tarred paper on the end of a section of a log or piece of timber and first cut the lower edge into notches, using only one angle of the tool. Then commence at the left side, and place the blade as indicated by the dotted lines, and strike at the end of the handle with a light mallet and a complete card is made. Continue in this manner across the paper. The first cut of every alternate course will make an imperfect card, and the last cut in any course may be imperfect, but the other cuts will make perfect cards if the tool is correctly made and properly used.

The cards should be placed about the plants at the time of transplanting. To place the card bend it slightly to open the slit, then slip it on the center, the stem entering the slit, after which spread the card out flat and press the points

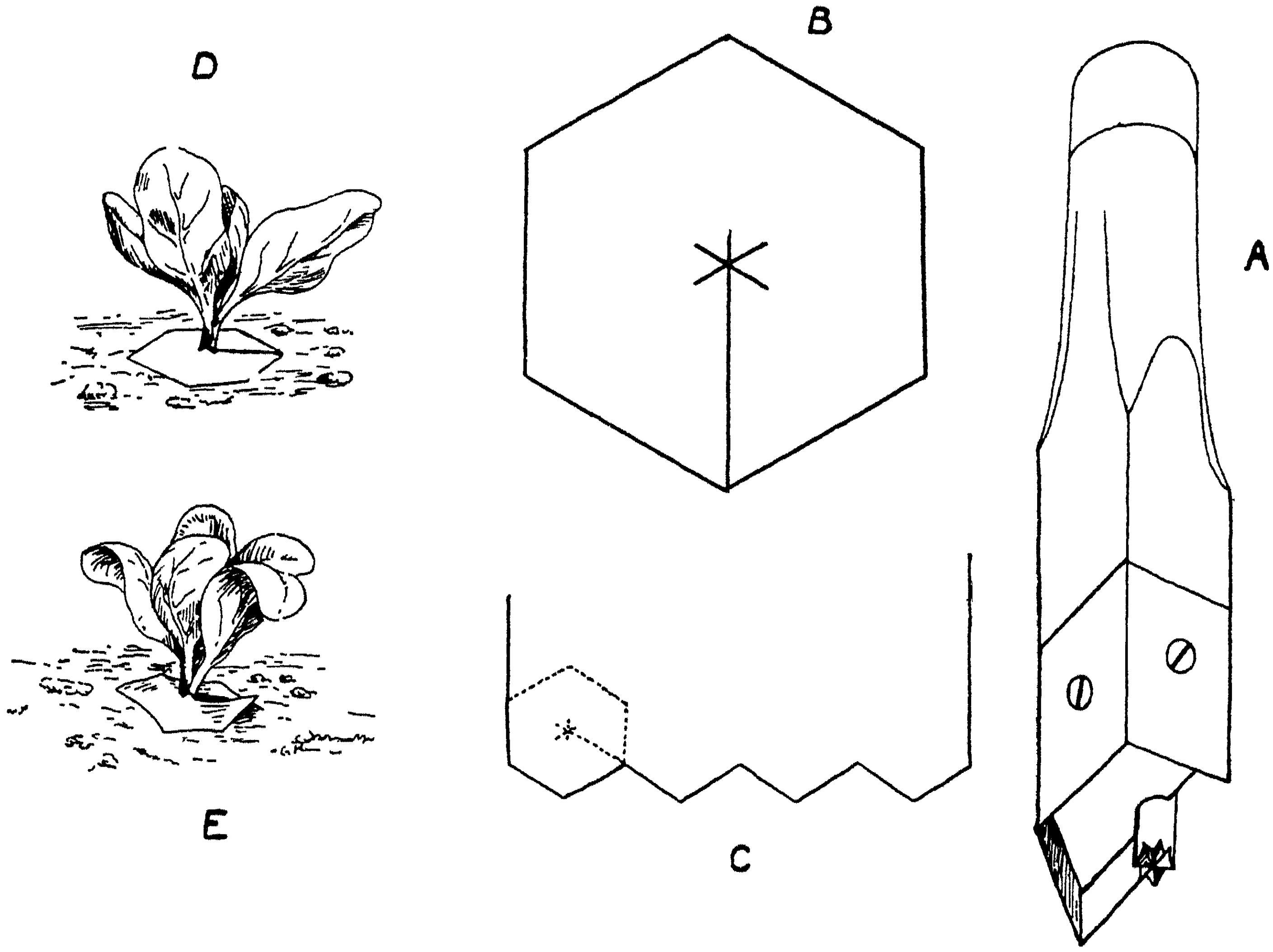

Fig. 5. Tarred Paper Disc and Tool for Cutting.

formed by the star-shaped cut snugly around the stem.

A Wisconsin grower protected 7,000 plants and secured a splendid crop, while unprotected plants nearby would have been a complete failure if the maggots had not been picked off by hand. Others have reported similar success. One reported having lost only 25 plants out of 10,000 to 15,000 that he protected with the cards, where ordinarily he should have lost from 75 to 90 per cent of the crop.

This method in actual practice has proved to be cheap, practical and efficient. Its success depends on the timely and proper application of the cards. They should be applied as soon after transplanting as convenient and must be pressed down firmly about the plant, leaving no open spaces. Soil should not be allowed to collect on top of the disc.

Remedial

In reviewing the current economic literature as well as in local practice, as revealed by our correspondence, I find the results attending the use of the materials for the control of this pest are as varied as the materials themselves. That many of the treatments recommended are impractical is certain. Of those remaining none now in current use seem to give uniform satisfaction under all conditions.

The Carbolic Acid Emulsion.—While giving negative results in our trials, had earlier in the season been suggested to growers, who in several cases commented upon its use most favorably. It is possible the solution was too strong; certainly more trials are necessary to prove the status of this remedy for our conditions. It is prepared as follows:

Crude carbolic acid	1 pint
Hard soap	1 pound
Water	1 gallon

Dissolve the soap in the boiling water; remove from the fire and add the carbolic acid. Agitate briskly for some time to form a perfect emulsion. For application use one part of the emulsion to 30 parts of water.

In using this solution draw back the soil from about the plant, exposing as much root surface as practical. Apply about half pint of the material to each

plant. If a pump is used and the solution applied with considerable force, it will require less material and do more good than when simply poured about the plant. This solution should be applied to the plants as soon as they are well established in the field and the application repeated about every eight or ten days.

Kerosene and Sand.—This mixture is made by adding one pint of kerosene to a bucketful of sand, mixing thoroughly. A handful of this substance is placed about each plant as soon as it is well established.

Powdered Tobacco. — This material should be placed about the plant as soon as it is set and the application renewed every week.

Bran and Glue.—This mixture consists of two pounds of glue dissolved in a gallon of water and the addition of sufficient bran to make a thin slop. A handful of this is then placed about each plant. This material, in certain cases, has given very satisfactory results.

Hellebore Decoction.—This solution is prepared by steeping two ounces of powdered hellebore in a quart of water for one-half hour. Dilute to make one gallon of solution. Apply in the same manner as the carbolic acid emulsion solution.

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Common Cabbage Looper
Autographa brassicae

The larva is a green worm, lined with white about one and a quarter inch long when grown. Has the looping habit like the span worm. Eats the leaves full of holes.

Spraying with salt water is useful.

Treat same as for imported cabbage worm.

Cross-Striped Cabbage Worm
Pionea rimosalis Guen

The moth is pale yellow in color and lays its eggs in masses of 20-40 on the under side of leaves, the eggs overlapping each other like fish scales. The young larva is gray in color with a large head. When full grown it is bluish gray with conspicuous black stripes crosswise of the body.

Distributed from the South Atlantic states westward to Nebraska.

The worms do considerable damage at times. Poison bran mash is a standard remedy. Mix bran with water and sugar before adding the Paris green. Three ounces of sugar to enough bran to make a mixture that will run through the fingers when mixed in a gallon of water.

Cooperation in clean farming is a good preventive. Gather and destroy all refuse from the cabbage fields.

Cutworms
Noctuidae

A. L. Lovett

Cutworms are a very serious pest of nearly all our crops. Ornamental shrubs, garden and truck crops, field crops and even small fruits and orchards suffer from the attack of these pests. The sleek, well fed, greasy caterpillars, varying in size, when mature, from one to two inches, are too well known to require a description. The adult moths are nocturnal in habit, flying mostly at night.

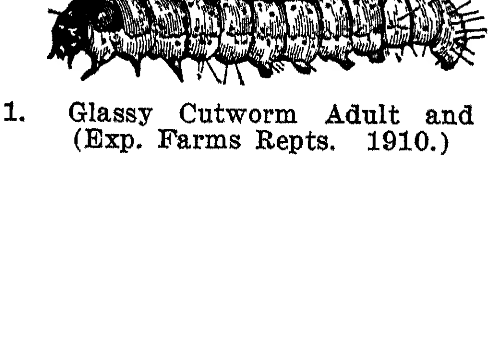

Fig. 1. Glassy Cutworm Adult and Larva (Exp. Farms Repts. 1910.)

The majority of the medium sized, smoky grey and brownish moths, which are attracted to the lights, are adults of the cutworm caterpillars.

Remedies

The poison bran mash, consisting of bran 16 pounds, Paris green one pound, salt one-half pound, cheap syrup one gallon, and warm water to make a coarse mash, is the standard remedy for cutworms. This may be placed on a field prepared for a crop or may be placed about the base of the plants when they appear. Poultry should not be allowed free range over a treated field. Green succulent forage of any kind may be sprayed with an arsenical, mowed and placed in small heaps about the field, preferably in the evening. Where these methods are impracticable, arsenical sprays applied to the host are of some assistance. For young plants just set in the field, as cabbage and tomato, a mechanical barrier consisting of a cylinder of tin or cardboard may be shoved down about the plant.

For the climbing cutworms, which attack the developing buds of our fruit trees in early spring, the poison baits are very good; but better still, is a belt of some sticky material about the trunk of the tree, or some mechanical device such as a piece of cardboard attached funnel shaped, tight at the top and flared below. Cotton batten may be used in a similar manner. Wrap a strip eight inches wide about the tree overlapping it at the edges where it meets. Tie this band at the lower edge, then, taking hold of the upper edge, roll it down over the bottom edge. This makes a very effective funnel.

Diamond-Back Moth

Plutella maculipennis

The larva is a very small green worm. The moth is about one-third inch long and folds its wings roof-like over its body. A white line borders the inside of each fore wing and these coalesce to form a single white stripe down the back with diamond-shaped expansions at intervals when the wings are folded.

Larvae usually feed on lower surface of leaves and not until quite numerous do they eat holes clear through.

Treat the same as for imported cabbage worm.

A. D. SELBY

Dipterous Leaf Miners

There are several species, notably the imported turnip leaf miner, native cabbage leaf miner, imported cabbage leaf miner, native clover leaf miner.

They are minute flies which lay their eggs in the cabbage and other plant leaves, the young larvae ruining the leaf. Not very injurious and no practical remedy is known.

Flea Beetles
Several Species

Minute beetles that jump like fleas when disturbed.

They eat small holes in the leaves of the plant, or if numerous, destroy whole sections of the leaf.

Spray with Bordeaux mixture.

Harlequin Cabbage Bug

Murgantia histrionica Hahn

Family Pentatomidae

General Appearance

The adult bugs are black with bright red markings. They are one half inch long and two-thirds as wide. The eggs are almost imitations of miniature white barrels with black hoops and black spots in the proper places for bungholes. They are arranged in clusters side by side. The young greatly resemble the adults, but lack wings and yellow predominates. This color gradually changes to orange and red as the nymphs reach maturity.

Life History

The adults hibernate in various sheltered places over winter and appear with the first warm weather in the spring to feed. The first plants to furnish food are wild mustard, radish and other members of the cruciferous weeds. Upon these also the eggs are laid and the young soon appear in great numbers in time to migrate to the cabbage plants and work upon them throughout the summer. Successive broods may appear in the

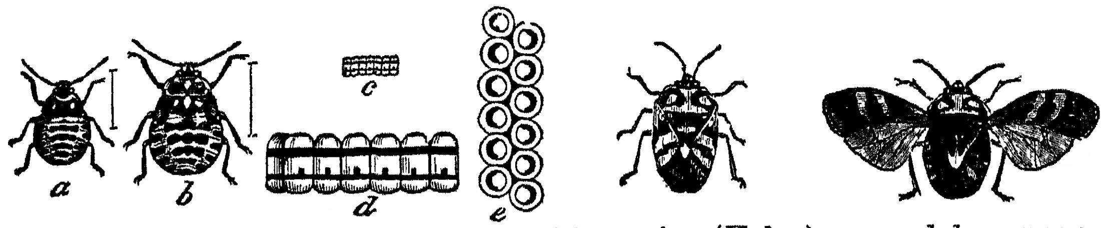

Fig. 1. The Cabbage Bug, *Murgantia histrionica* (Hahn.). *a* and *b*, young; *c*, *d* and *e*, eggs; adults at right.

—*After Riley*

cabbage fields and the numbers so increase as to cause much damage. In the southern part of the state the adults continue active throughout the winter.

Food Plants

This bug is especially fond of all cruciferous plants, including mustard, radish, cabbage, cauliflower, turnips, rape, horseradish, etc. Other food plants are potatoes, eggplant, okra, beans, beets, roses, sunflowers, chrysanthemums, squash, ragweed, pigweed, wild lettuce, lambsquarters and most of the plants belonging to the caper family. Occasionally nursery trees, citrus, locust, cherry, and plum are injured, and the fruit of the grape and corn ears also suffer.

Control

Methods recommended for the squash bug are also applicable to the control of the cabbage bug. Planting an early crop of cabbage, rape, mustard or radish is especially recommended. The eggs are laid in great numbers upon these plants and together with the adults may be destroyed. This practice greatly lessens subsequent attacks.

See under *Squash*.

Natural Enemies

Great numbers of the eggs are destroyed by two small internal parasites, *Trissolcus murgantiae* Ashm. and *Ooencyrtus johnsoni* How. The wheel bug, *Arilus cristatus* Linn., feeds upon the young nymphs in the Eastern states.

E. O. Essig

Hop Flea Beetle

Psylliodes punctulata Melsh

Family Chrysomelidae

General Appearance

A very small, black metallic beetle with greenish tinge; oval in form; one tenth of an inch long and half as wide. The eggs are very small, oval in shape and yellow. The larvae are small white grubs about 5 mm. long. The white pupae as well as the larvae are found in the soil.

Life History

The adults appear early in the spring and are ready to attack the first hop plants as soon as they come through the ground. They feed upon the upper surfaces of the leaves, completely skeletonizing them. The vines are attacked when young and are often completely destroyed before they have reached a height of three or four feet. When disturbed the beetles hop or fall to the ground. They are able to make their way through the soil without much difficulty and lay their eggs upon the roots of the food plants.

The larvae are very small and white in color with dusky markings. They live in the ground feeding upon the roots of various plants. When full grown they pupate in the soil from which the adults emerge throughout nearly the entire year, the largest number appearing from early spring to August. There are probably two generations a year.

Food Plants

This species feeds upon hops, cabbage, potatoes, beets, turnips, dock, lambsquarters, pigweed, clover, rhubarb, cucumber, radish, mustard and nettle.

Control

There have been numerous methods of control recommended for this pest. The measures directed against the hibernating beetles consist in killing all on the poles or burning up the rubbish. In the spring the first step consists in capturing the adult beetles on the young vines. A tarred board or hand hopper dozer is used on or into which the beetles are shaken. Tanglefoot bands around the bases of the tresseled vines, as well as around the poles, not only keep the beetles from the

foliage but capture great quantities of them. Various contract sprays, such as tobacco extract, emulsions, soaps, resin wash, and arsenic also have been used with good effect, but the cost due to great numbers of applications necessary, makes them almost prohibitive.

E. O. ESSIG

Imported Cabbage Web Worm

Hellula undalis, Fab

The moth is gray in color with mottled fore wings which have an expanse of about five-eighths of an inch. The full-grown larvae are about half an inch long, grayish-yellow with five longitudinal bands.

Distributed pretty well over the South and Southeast. Does considerable damage to cabbages, turnips, beets and the cruciferae generally.

Several species of flies are parasites.

Bordeaux mixture sprayed on the plants when first set out acts as a repellent. Clean culture and destruction of refuse material is also suggested.

Literature

Bureau Entomology Bulletin 109, Pt. III.

Division Entomology Bulletin 33, New Series.

Imported Cabbage Worm

Pontia rapae Sch.

Family Pieridae

Pieris rapae Linn.

General Appearance

Though this is an imported insect it has become as common as if it had always been here. The adult butterflies are about one and one-fourth inches long with a wing expanse of two inches. The color is white with two small black spots near the middle and a large black spot at the tip of each fore wing. The caterpillars are light velvety green in color and very finely dotted with minute dark spots. The length when full grown varies from one to one and one half inches. The chrysalis is about one inch long and varies in color from yellow to green, light or dark gray.

Life History

In the northern part of the state the species winters over in the chrysalis stage, while in the south adult butterflies may be seen almost any time of the year. They become very much in evidence early in March and are active throughout the entire summer and fall. Egg laying begins soon after the adults leave the chrysalis stage. The eggs hatch in about a week and the young caterpillars begin feeding at once. They first feed upon the outer leaves, making them ragged and holey, but gradually work through towards the heart of the cabbage, leaving the dark-green excrement to mark their paths of destruction. The growth is very

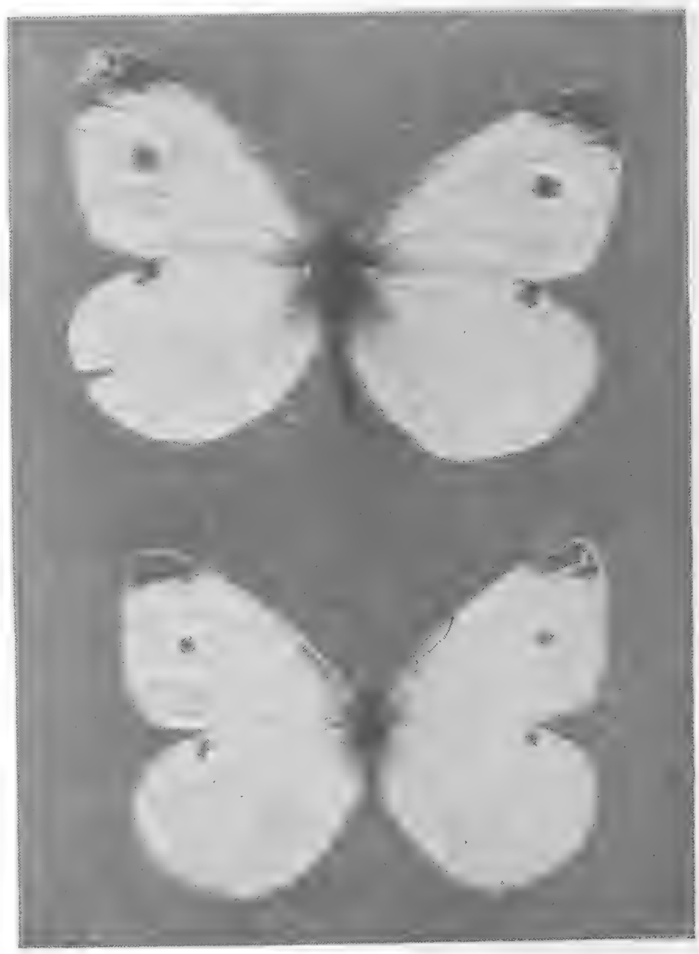

Fig. 1. Adults, Imported Cabbage Worm. (Tennessee Experiment Station)

rapid so that in from one to two weeks they are ready to select some secluded spot beneath an old cabbage leaf or some nearby object and prepare for the chrysalis stage, which, during the first two generations in the summer months, lasts little longer than the larval stage, but which in the fall continues throughout the winter. There are several generations a year. In fact in the southern part of the state it seems as if the breeding is only slightly checked during the winter months.

Food Plants

The principal economic food plants are cabbage, cauliflower, brussels sprouts, turnip, radish, mustard, and horseradish. Other plants attacked are wild mustard, wild radish, nasturtium, mignonette and sweet alyssum.

Control

The larvae, working as they do into the heads of the cabbages, make control methods practically impossible after they have once begun. Young plants may well be protected by arsenical sprays which are applied with safety until the heads are half grown. Prof. L. Bruner claims that cornmeal dusted on the cabbages causes the worms to leave. Clean culture should be practiced and no cabbage or host plants allowed to grow during the interval between crops unless they are freely sprayed with strong solutions of arsenical sprays.

Natural Enemies

Internal parasites, working upon the chrysalids, are important factors in the control of the pest. In this state the small parasite *(Pteromalus puparum)* is quite widely distributed and is bred and sent to all parts of the state by the State Insectary. In the Eastern states a chalcid *(Apanteles glomeratus)* does excellent work in killing off the caterpillars, but this has not been established in this state. A bug *(Phymata wolffii)* preys upon the butterflies, which they capture on flowers while the wasp *(Polistes pallipes)* destroys large numbers of the worms.

E. O. Essig

(Further remedies suggested by A. L. Lovett, of Oregon Experiment Station —Ed.)

For very small plants use Paris green one pound, and air slaked lime, road dust or cheap flour 20 pounds. Mix thoroughly and dust over plants by sifting through a coarse sack. This material will adhere better if applied in the early morning while the dew is on.

For older plants the regular arsenical sprays may be used, adding a little soap to aid them in sticking, or better still, use the resin lime mixture prepared as follows:

Stock solution:

Pulverized resin	5 pounds
Concentrated lye	1 pound
Fish oil soap or any cheap animal oil, except tallow	1 pint
Water	5 gallons

Place the oil, resin and one gallon of hot water in vessel for cooking. Heat until the resin is softened, add the lye solution made as for hard soap, stir thoroughly and add four gallons more of hot water. Boil for two hours or until the mixture will unite readily with water, making a clear amber liquid. Add water to make up for that lost by evaporation. This constitutes the stock solution and may be kept indefinitely. In applying it, for every gallon of the stock solution add first 16 gallons of water, then three gallons of thin whitewash and one-quarter pound of Paris green.

Hot water at a temperature of 130 Fahrenheit will kill the worms and will not injure the cabbage plants.

Native Cabbage Worm

Pontia protodice. Pieris protodice

Butterfly, looks much like the last, but has about four angular black marks at and behind tips. Female very different from male, with wings all checkered with black.

Worm, obscure, purple color, with four longitudinal pale yellow stripes, two on each side. Head and body minutely dotted with black. Pupa, in the main, like the last, but dotted with black. The worm, though not nearly so troublesome as the imported, can be overcome by the same sprays.

L. F. Henderson

Seed-stalk Weevil

Ceutorhynchus quadridens Panz

A somewhat serious pest in sections where seed cabbages are grown, as in Long Island. No remedy suggested.

Western Twelve-Spotted Cucumber Beetles. See under *Cucumber*.

Literature

Bulletins of the State Experiment Stations and the United States Department of Agriculture, mostly of the last two decades:

Common Cabbage Looper

Autographa (Plusia) brassicae Riley

1884. The cabbage plusia.—C. V. Riley (U. S. D. A. Rpt., 1883, pp. 119-122, pls. 2).
1893. A few common insect pests.—C. P. Gillette (Colo. Bul. 24, pp. 8, 9, fig. 1).

1898. A spraying mixture for cauliflower and cabbage worms.—F. A. Sirrine (N. Y. State Bul. 144, pp. 38-46, pl. 1).

1902. Some insects injurious to vegetable crops.—F. H. Chittenden (U. S. D. A., Bur. Ent. Bul. 33, pp. 60-69, figs. 2).

1909. Some cabbage worms and suggestions for destroying them.—W. E. Rumsey and Fred E. Brooks (W. Va. Bul. 120, pp. 345-352, pls. 2).

Diamond-back Moth

Plutella maculipennis (cruciferarum) Curtis

1892. Insects injurious to the cabbage. —H. E. Weed (Miss. Bul. 21, pp. 8, 9, fig. 1).

1893. Injurious insects of Maryland.—C. V. Riley (Md. Bul. 23, pp. 83, 84, fig. 1).

1895. The pests of the orchard and garden.—L. R. Taft and G. C. Davis (Mich. Bul. 121, p. 62, fig. 1).

Imported Cabbage Worms

Pontia (Pieris) rapae Linn

1889. Important injurious insects.—C. P. Gillette (Ia. Bul. 5, pp. 171-174, fig. 5).

1894. Insects affecting late cabbage.—F. A. Sirrine (N. Y. State Bul. 83, pp. 658-666, pl. 1).

1895. Treatment of common diseases and insects injurious to fruits and vegetables.—S. A. Beach and W. Paddock (N. Y. State Bul. 86, pp. 98, 99).

1895. Insects injurious to fruits and vegetables.—J. T. Stinson (Ark. Bul. 33, pp. 81, 82, figs. 2).

1905. The imported cabbage worm.—F. H. Chittenden (U. S. D. A. Bur. Ent. Circ. 60, pp. 8, fig. 6).

1907. Imported cabbage butterfly (N. Y. State [Geneva] Rept. 25, Pt. 3, pp. 243-245, pl. 1).

Southern Cabbage Butterfly

Pontia (Pieris) protodice Boisd.

Potherb Butterfly

Pontia (Pieris) napi Linn

Cross-striped Cabbage Worm

Evergestis (Pionea) rimosalis Guen

Cutworms

Various species of Noctuids

1895. Cabbage cut worms.—C. V. Riley (U. S. D. A. Rpt. 1884, pp. 289-300, figs. 10) Describes the following:

Dark-sided cutworm, *Agrotis messoria* Harr.

Granulated cutworm, *Agrotis annexa* Treitschke.

Shagreened cutworm, *Agrotis malefida* Guen.

W-marked cutworm, *Agrotis clandestina* Harr.

Greasy cutworm, *Agrotis ypsilon* Rott.

Speckled cutworm, *Mamestra subjuncta* G. & R.

Glassy cutworm, *Hadena devastatrix*, Brace.

Variegated cutworm, *Agrotis saucia* Treitschke.

1895. Cutworms, etc.—J. B. Smith (N. J. Bul. 109, pp. 3-13, figs. 3).

1895. Cutworms in Kentucky. — H. Garman (Ky. Bul. 58, pp. 89-107, pl. 1).

1895. Climbing cutworms in Western New York.—M. V. Slingerland (N. Y. Cornell Bul. 104, pp. 553-600, pls. 5, figs. 2).

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1896. Some injurious insects.—G. C. Davis (Mich. Bul. 132, pp. 3-14, figs. 8).

1907. Cutworms. — H. T. Fernald (Mass. Circ. 2, pp. 2).

Imported Cabbage Webworm

Hellula undalis Fab.

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Cabbage Aphis

Aphis brassicae Linn

1890. Plant lice and how to deal with them.—J. B. Smith (N. J. Bul. 72, pp. 16-20, figs. 2).

1892. Horticulture and entomology.—E. S. Richman (Utah Bul. 14, pp. 7-10, figs. 7).

1893. Miscellaneous entomological papers.—F. M. Webster (Ohio Bul. 51, pp. 109-111).

1897. Some common injurious plant lice, with suggestions for their destruction.—W. G. Johnson (Md. Bul. 48, pp. 97, 98, fig. 1).

1909. Some insects injurious to cabbage, cucumbers and related crops.—F. H. Chittenden (Va. Truck Sta. Bul. 2, pp. 22-30, figs. 4).

Cabbage Root Maggot
Pegomya (Phorbia) brassicae Bouche

1894. The cabbage root maggot, with notes on the onion maggot and allied insects.—M. V. Slingerland (N. Y. Cornell Bul. 78, pp. 481-577, figs. 18).

1905. Root maggots and how to control them.—F. H. Chittenden (U. S. D. A., Bur. Ent. Circ. 63, pp. 7, figs. 5).

1905. Cabbage root maggot. Poisoned bran for cutworms.—W. S. Blair (Canada Exp. Farms Rpt. 1904, pp. 362-364).

1906. The cabbage maggot and other injurious insects of 1906.—F. L. Washburn (Minn. Bul. 100, pp. 1-19, cld. pl. 1, figs. 11).

1907. The cabbage and onion maggots. —John B. Smith and E. L. Dickerson (N. J. Exp. Sta. Bul. 200, pp. 27, figs. 13).

1907. The cabbage maggot and other injurious insects of 1906.—F. L. Washburn (Minn. Bul. 100, pp. 87, pls. 7, figs. 57).

1907. Root maggots.—H. T. Fernald (Mass. Circ. 5, pp. 2).

1908. The apple leaf hopper and other injurious insects of 1907 and 1908.—F. L. Washburn (Minn. Bul. 112, pp. 196-213, figs. 3).

1908. Screening for the protection of cabbage seedbeds.—W. J. Schoene (N. Y. State Bul. 301, pp. 165-174, pl. 1).

Cabbage Flea Beetle, or Striped Turnip Flea Beetle
Phyllotreta vittata Fab.

1885. The wavy-striped flea beetle.—C. V. Riley (U. S. D. A. Rpt. 1884, pp. 301-304, fig. 1).

1890. The cabbage flea beetle.—H. Garman (Ky.) Rpt. 1889, pp. 23-25).

1891. The striped flea beetle or cabbage flea.—A. D. Hopkins (W. Va. Rpt. 1890, pp. 147-150).

1895. Remedies for flea beetles.—C. M. Weed (N. H. Bul. 29, pp. 3-7, figs. 5).

Harlequin Cabbage Bug
Murgantia histionica Hahn

1908. The harlequin cabbage bug.—F. H. Chittenden (U. S. D. A., Bur. Ent. Circ. 103, pp. 10, fig. 1).

False Chinch Bug
Nysius angustatus Uhl

1894. Chinch bugs.—L. Brunner and H. G. Barber (Neb. Bul. 34, pp. 153, 154, fig. 1).

Cabbage Curculio
Coutorhynchus rapae Gyll

1900. Some insects injurious to garden crops.—F. H. Chittenden (U. S. D. A., Bur. Ent. Bul. 23, pp. 39-53, figs. 2).

Cabbage Hair Worm
Mermis spp et al.

1905. Cabbage snakes.—H. Garman (Ky. Bul. 120, pp. 78-81, pl. 1).

1908. The cabbage hair worm.—F. H. Chittenden (U. S. D. A., Bur. Ent. Circ. 62, pp. 6, fig. 1).

Lists of Books and Pamphlets

1901. Bibliography of the more important contributions to American economic entomology. Part VII. — Nathan Banks (U. S. D. A., Bur. Ent., pp. 113). Price, cloth, 20 cents. Postage, 3 cents. (Covers the period between December 31, 1896, and January 1, 1909).

1905. Bibliography, etc. (as above).—Nathan Banks (U. S. D. A., Bur. Ent., pp. 132). Price, 10 cents. Postage, 3 cents. (Covers the period between December 31, 1899, and January 1, 1905).

1910. A list of works on North American entomology—Nathan Banks, (U. S. D. A., Bur. Ent. Bul. 81, pp. 120). Price, 15 cents. Postage, 4 cents.

(Application and money for these bibliographies should be sent to Superintendent of Documents, Government Printing Office, Washington, D. C.)

Useful works on economic entomology, containing information on the pests of cole crops.

1902. Insects injurious to staple crops. —E. D. Sanderson (New York; John Wiley & Sons, pp. 205, figs. 162). Price, $1.50.

1906. Economic entomology.—J. B. Smith (Philadelphia: J. B. Lippincott Co., pp. 475, figs. 475). Price, $2.50.

1907. Insects injurious to vegetables. —F. H. Chittenden (New York: Orange Judd Co., pp. 262, figs. 163). Price, $1.50.

Bulletins covering in a general manner the treatment of cabbage insects.

1904. Cabbage diseases and insects.— J. B. S. Norton and T. B. Symons (Md. Circ. Bul. 58, pp. 10, figs. 6).

1904. Insects injurious to cabbage.—H. Garman (Ky. Bul. 114, pp. 15-47, figs. 17).

1906. Cabbages for stock feeding.—S. Fraser (N. Y. Cornell Bul. 242, pp. 69, 70).

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California

California grows more fruit than any other state in the Union. It is not as large as Texas but its coast line on the west, its high mountain ranges on the east and west extending from north to south through the whole length of the state, and its great central plain, the climate of which is modified by the ocean breezes cooling the temperature in summer and modifying its severity in the winter, make it better adapted to all kinds of fruits, from the semi-tropical to the hardier fruits grown generally in the northern climates, than any other portion of the United States. It has a great variety of soils, as well as of climate. Sometimes within a few miles of each other, two different points, on account of altitude, wind currents, ocean breezes, or difference in soils, may be adapted to the growing of fruits that are generally found at great distances from each other, in other parts of the United States. California grows fewer apples than New York, Pennsylvania or Missouri, and a number of other states, but not far from the apple-growing region may be found oranges, lemons, and other semi-tropical fruits. These fruits have produced immense wealth and have enabled the inhabitants to make beautiful homes, while at the same time there are regions that partake largely of the nature of the arid districts of other states. It has a coast line of 900 miles.

GRANVILLE LOWTHER

Harvest Time for Various Crops in California

The following table shows the time at which some of the various fruits, vegetables, and garden products are harvested:

Almonds	August to September
Apples	July to November
Apricots	June to August
Blackberries	June to September
Cantaloupes	May to July
Cherries	May to July
Currants	May to June
Dewberries	May to July
Figs	July to November
Grapes	July to January
Grape Fruit	All the year
Guavas	All the year (two crops)
Lemons	All the year
Limes	All the year
Loganberries	June to September
Loquats	May and June
Mulberries	July to September
Nectarines	June to August
Olives	October to January
Oranges	October to January
Pears	July to November
Peaches	July to Christmas
Persimmons, Japanese	November and December
Plums	June to September
Prunes	June to September
Pomegranates	September to December
Quinces	October to December
Raspberries	June to October
Strawberries	All the year
Watermelons	July to October

Vegetables

Asparagus	March to July
Beans	May to October
Cabbage	All the year
Cauliflower	October to June
Celery	October to June
Corn	May to October
Cucumbers	April to November
Lettuce	All the year
Melons	May to October
Onions	All the year
Peas	All the year
Potatoes. two crops plant	August and February
Radishes	All the year

E. J. WICKSON

Frost and Precipitation in California

Station	No.	Frost				Precipitation
		Average Date of		Date of		Annual
		First killing Autumn	Last in Spring	Earliest in Autumn	Latest in Spring	inches
Sission	1	Sept. 26	May 26	Sept. 13	July 6	37.8
Cedarville	2	Sept. 27	May 11	Sept. 14	June 2	13.7
Eureka	3	Nov. 15	Apr. 9	Nov. 7	May 1	45.8
Redding	4	Dec. 3	Mar. 23	Nov. 20	May 1	36.2
Susanville	5	Oct. 3	May 10	Sept. 8	May 22	22.9
Red Bluff	6	Nov. 25	Mar. 15	Nov. 7	Apr. 19	25.7
Chico	7	Dec. 14	Mar. 24	Dec. 12	Apr. 10	22.4
La Porte	8	Sept. 15	May 31	Sept. 6	July 6	77.9
Ukiah	9	Nov. 26	Mar. 27	Oct. 16	May 2	35.0
Summit	10	....	....	....	....	46.9
Auburn	11	....	....	....	....	33.4
Davisville	12	Dec. 7	Feb. 26	Nov. 26	Apr. 4	16.6
Sacramento	13	Nov. 15	Feb. 16	Oct. 28	Apr. 26	19.9
Napa	14	Dec. 24	Feb. 27	Nov. 27	Mar. 30	23.7
San Francisco	15	....	Jan. 25	Dec. 13	Apr. 20	22.5
Livermore	16	Dec. 2	Feb. 23	Nov. 9	Apr. 12	15.3
San Jose	17	Dec. 6	Feb. 8	Nov. 28	Feb. 18	14.8
Merced	18	Dec. 11	Mar. 5	Nov. 28	Mar. 28	10.3
Santa Cruz	19	Dec. 7	Mar. 12	Nov. 26	Mar. 30	27.0
Hollister	20	Nov. 23	Mar. 16	Nov. 8	Apr. 27	12.3
Fresno	21	Dec. 15	Mar. 4	Nov. 18	Apr. 14	9.2
Independence	22	Oct. 25	Mar. 17	Sept. 21	May 28	3.7
King City	23	....	....	....	....	10.8
Visalia	24	Nov. 21	Apr. 11	Nov. 16	Apr. 11	9.8
San Luis Obispo	25	Dec. 17	Mar. 17	Nov. 15	Apr. 8	19.2
Bakersfield	26	....	....	....	....	4.8
Santa Barbara	27	....	....	....	....	16.6
Los Angeles	28	....	Apr. 8	Dec. 12	Apr. 8	15.6
Redlands	29	Dec. 12	Feb. 19	Nov. 24	Apr. 29	14.8
Needles	30	....	....	....	....	2.7
Salton	31	....	....	....	....	2.5
San Diego	32	....	....	....	....	9.4

Table of Productiveness

A table of productiveness of various articles that can be raised on one acre of ground in California:

Alfalfa	$ 35	to	$ 60
Almonds	75	to	200
Apples	100	to	200
Apricots	75	to	150
Asparagus	100	to	250
Berries	150	to	500
Blackberries	250	to	500
Beans	30	to	100
Cherries	100	to	225
Chestnuts	150	to	400
Figs	100	to	250
Loganberries	250	to	300
Lemons	100	to	400
Melons	$ 25	to	$125
Nectarines	100	to	200
Olives	75	to	150
Oranges	150	to	800
Peaches	100	to	250
Potatoes (Sweet)	50	to	150
Potatoes (Irish)	50	to	150
Prunes	75	to	200
Pears	100	to	400
Pomelos	100	to	400
Plums	100	to	200
Pecans	150	to	600
Quinces	100	to	200
Raisin Grapes	75	to	150
Strawberries	150	to	300
Table Grapes	100	to	500
Tomatoes	50	to	150
Walnuts	200	to	800

E. J. Wickson

California Canned Fruits and Vegetable Packs

(Compiled yearly by California Fruit Grower from individual packers' reports.)

FRUIT	1911 Cases		1910 Cases		1909 Cases	
	Nos. 2½ and 3, etc. (all grades)	(No. 8 gallons) (all grades)	Nos. 2½ and 3, etc. (all grades)	(No. 8 gallons) (all grades)	Nos. 2½ and 3, etc. (all grades)	(No. 8 gallons) (all grades)
Apples	8,750	56,550	6,280	70,550	7,375	62,600
Apricots	708,500	149,825	544,530	198,630	563,660	100,450
Blackberries	35,250	42,575	26,425	35,600	22,625	27,330
Cherries, Royal Ann	99,700	11,740	123,240	13,050	110,250	7,450
Cherries, black	26,860	2,005	18,110	1,510	16,700	1,375
Cherries, white	49,730	8,770	33,410	5,875	51,640	4,520
Grapes	62,115	8,800	39,285	6,360	20,105	4,365
Loganberries	12,106	7,011	6,977	5,662	3,204	808
Nectarines	5	18	....	1	....	14
Pears	579,960	38,960	568,125	51,230	466,530	34,910
Peaches, free	582,200	156,200	553,000	195,825	401,800	145,375
Peaches, cling	1,210,525	142,200	1,233,200	163,425	779,725	109,260
Plums	143,350	22,490	65,550	14,810	75,450	13,975
Raspberries	2,950	675	9,335	791	3,375	215
Strawberries	6,505	1,210	13,225	848	9,690	890
Other fruits	1,390	3,725	2,250	1,440	700	635
Total fruits (cases)	3,529,896	652,754	3,242,942	765,607	2,532,829	514,172
Grand total fruits	4,182,650		4,008,549		3,047,001	
VEGETABLES						
Asparagus	684,960	2,105	614,050	3,225	410,335	630
Beans	53,110	12,710	41,610	4,640	10,490	1,945
Peas	162,570	22,205	140,855	26,920	88,360	15,650
Tomatoes	1,306,190	209,260	1,159,875	190,435	567,300	104,960
Other vegetables	39,575	23,970	49,075	19,960	38,350	4,700
Total vegetables (cases)	2,246,405	270,250	2,005,465	245,180	1,114,835	127,885
Grand total vegetables	2,516,655		2,250,645		1,242,720	
Grand total pack (cases)	6,699,305		6,259,194		4,289,721	

—From Annual Review Number 1912 California Fruit Grower, page 17.

THE CALIFORNIA CITRUS INDUSTRY

Growing of citrus fruits in California is rapidly advancing in acreage and in product, each year receiving greater investment and effort, and each year reaching a greater aggregate gross return for the product marketed. There has also been gratifying progress made in meeting the problems and difficulties which are bound to arise in the development of an industry, involving so many novel situations and affecting so many interests—individual, corporate, and political. In the following brief statement I shall endeavor to indicate what seem to me the most salient features of the California citrus industry, chiefly from the commercial point of view.

California Citrus Census

The report of the California State Board of Equalization, which presents the figures gathered by the assessors in all the counties of the state, shows that there were growing in the spring of 1912 the following totals of citrus trees in California, viz.:

	No. of trees Bearing	No. of trees Non-Bearing
Lemon	952,290	743,352
Lime	1,371	450
Orange	6,013,272	633,366
Pomelo	11,321	6,280
Totals	6,978,254	1,383,448

These figures show the leadership of the orange, the rather remote second of the lemon, and the fact that the two show about the same rate of increase through recent plantings. They also indicate a greater rate of increase in the pomelo, though the total is still insignificant, and that the lime is only a curiosity. Other citrus fruits are too small in number for enumeration.

Taking the orange and lemon as a measure of the citrus geography of California, and choosing counties having more than 100,000 trees, bearing and non-bearing, according to the 1912 report of the California State Horticultural Commissioner, the following statement results:

Counties	Number of Orange trees	Number of Lemon trees
San Bernardino	3,720,320	385,490
Los Angeles	2,431,000	852,500
Riverside	1,934,790	392,676
Tulare	3,412,000*	......
Orange	929,480	237,405
Ventura	204,961	298,176
Butte	192,168	3,032
Fresno	170,000	5,200
San Diego	101,017	295,957
Santa Barbara	599	297,386

These counties are distributed through a north and south distance of about 550 miles, and the interest is concentrated toward the south and widely scattered toward the north, with much intervening land as good for citrus fruits as that already planted. Citrus fruits are equally safe throughout the whole distance, and it is clear that California has a capacity for citrus production far beyond present attainment, if greater amounts of fruit can be profitably sold, as it certainly promises to be, if current protection is maintained.

Mr. G. Harold Powell, Secretary of the Citrus Protective League of California, estimates that California citrus plantings now occupy about 150,000 acres of land and represent in lands, trees, buildings and operating property of all kinds a value of $200,000,000. He also estimates the fruit produced at almost $40,000,000, valued at selling points. The annual shipments for several years have been as follows: 1908-9, 40,516 carloads; 1909-10, 33,099 carloads; 1910-11, 46,394 carloads and 1911-12, 40,290 carloads.

California Citrus Problems

Cultural problems connected with growing citrus fruits are many. Some of them have evidently reached a basis of settlement. For instance, nearly all insects are controlled by fumigation, and the remaining requirements are to do the work more effectively and economically. The problems of the development of irrigation water from streams or from underground sources and the distribution thereof have been well worked out, but the ministration of water to the tree so that its greatest vigor and producing efficiency shall be maintained is not yet satisfactorily mastered. The

* Orange and lemon trees together.

desirability of soil improvement, chemically and physically, by the growing and covering-in of legumes in the orchard has been fully demonstrated, but choice of particular plants and cultural policies are still to be determined. The use of fertilizers is constantly increasing and their indispensability recognized, but their relations to tillage, moisture distribution, and to the vegetative functions of the trees are still matters of conflicting opinions.

The Citrus Protective League

And yet the problems which California citrus growers wrestle with most successfully are commercial problems, and they have created unique organizations to labor for their solution. Mr. G. Harold Powell, then secretary and manager of the Citrus Protective League, in January, 1911, issued a general statement of the character and work of the organization from which the following generally significant paragraphs are taken:

The Citrus Protective League of California is a voluntary organization formed in March, 1906, by representatives of growers, shippers and shipping organizations in nearly all of the citrus growing localities in the state, to handle the public policy questions that affect the industry as a whole. Its purpose is to represent the grower and shipper in handling such questions as railroad rates and transportation problems; customs tariffs and other governmental relations, state and federal legislation that applies directly to the business; and all other questions of a general nature that affect the upbuilding of the industry, except the marketing of fruit.

The league is directed by an executive committee of nine and by a secretary and manager, the executive committee having been appointed by an administrative committee of 30 of the principal growers and shippers, who act as a governing committee, and who were selected from the representative delegates who organized the league in 1906.

The league is supported by funds raised by general assessment, based on the number of cars of fruit shipped by each member during the preceding year. Fourteen assessments were levied to December 31, 1910, and $68,654.88 has been paid in by the members in the five years since the league was organized, of which approximately $65,000 was expended in the management of its business to December 31, 1910.

The league has played an important part in the progress of the citrus industry in the past five years.

In 1907 it induced the railroads to reduce freight rates on oranges 10 cents per 100 pounds, from $1.25 to $1.15. This rate became effective February 26, 1907, since when it has saved the shippers from $28 to $30 per car. The gain to the industry from February 26, 1907, to December 31, 1910, from this reduction has been about $3,175,000, or about 45 times the entire cost of the league, from the date of organization to the present time.

Following the reduction in the freight rate and as a result of the succeeding agitation accompanying the refrigeration rate question, the railroads changed the refrigeration tariffs, allowing 32,000 pounds of fruit to be shipped in a 40-foot car at the same rate per car for refrigeration as applied before on 27,650 pounds. This change became effective July 5, 1909. It is estimated that the value of this change to the shipper is approximately $35,000 to date, or more than half of the entire cost of the league since its organization.

In 1908 the league began a movement to prevent the duty of one cent per pound on oranges being reduced by congress and to secure an increase of one-half cent per pound on lemons for the purpose of covering the extra cost in labor expended on the lemon above the labor cost expended on the orange. The league was successful in both of these efforts, the duty standing now at one cent per pound on the orange and one and one-half cents per pound on the lemon.

The league made an investigation of the methods used by the government in determining the amount of decay in im-

ports of lemons, and in refunding the duty to the importers on the same. The league determined that the federal system gave an advantage to the importer that was detrimental to the California citrus interests. It presented the matter to the secretary of the treasury, before whom it laid the data accumulated. A great deal of consideration has been given the question, and it is expected that the honorable secretary of the treasury will promulgate new regulations in the near future which will safeguard the interests of the government and protect the California industry from further unfair competition.

Two months after congress advanced the duty on imports of lemons from one cent to one and one-half cents a pound, the railroads, through the Transcontinental Freight Bureau, attempted to absorb part of the duty granted by congress by advancing the rate 15 cents per 100 pounds. The league secured a temporary injunction through the Circuit Court of the United States for the Southern District in California, restraining the railroad from collecting the proposed increase in rates. The commission subsequently found that the rate of $1.15 per 100 pounds on lemons was unreasonable and that the rate ought not to exceed $1 per 100 pounds.

At the same time the league questioned the reasonableness of the increased rate on lemons, and at the same time the reasonableness of the rate $1.15 per 100 pounds on oranges; and the reasonableness of the charges for refrigeration and pre-cooling charges, and the contentions of the growers were, in the main, sustained.

The league is actively engaged in an effort to sustain the import duties on citrus fruits to meet the determined efforts of importers to reduce these duties.

The league will use every effort to bring to the help of the grower special investigators from the state and federal governments to study the diseases, the insects, the soil problems, and other cultural, fruit handling and fruit transportation problems that affect the industry. It will maintain an agricultural reference library without expense to the grower, and will develop a bureau of information showing the international movement of citrus fruit and other fruits that have a relation to the industry.

The league is the only organization that has been formed by an agricultural industry in America, and probably in the world, to look after the general public policy questions that affect it. It represents 90 per cent of the growers and shippers of the state. The organization is a vital part of the industry, formed to protect and advance its interests.

The California Fruit Growers' Exchange

The greatest co-operative undertaking in fruit marketing in California is the California Fruit Growers' Exchange, organized in 1895 by the citrus fruit producers and systematically developed since that time until in scope, methods, mastery of the shipment and distribution, in development of markets and in reduced cost of placing the product therein, there is nothing comparable with it in the broad field of commercial agriculture. In March, 1911, B. A. Woodford, general manager of the exchange, prepared a careful statement of the standing and accomplishments of the organization from which the following facts, significant to producers of all kinds of fruits, are compiled:

Large and widely distributed citrus plantings began in Southern California about 1885, upon the basis of successful results attained in special localities during the previous decade. When these plantations came into bearing in considerable quantity, the ready market for cash at home that had existed for the fruit when the crop was small was found to be inadequate, and nearly 20 years ago, with an output of only 4,000 cars annually, the growers were unable to dispose of the entire crop under old methods at fair prices. Through the experience gained in their co-operative water companies, they found it comparatively easy to unite in establishing common packing houses in the various producing sections, which they themselves owned and controlled. These houses were conducted at actual

cost of operation, the expenses being usually apportioned on a box basis. The purpose of the association was, primarily, to bring about uniformity in grading and packing, and to reduce the cost of preparing the fruit for sale. These economies were shared by the grower alone.

In packing their fruits on a mutual basis the growers have, however, only solved in a small degree the real problem that confronted them and, to get the full benefit of co-operation, it became necessary to extend these joint operations to the distribution and sale of the fruit. The result was the formation of the California Fruit Growers' Exchange, to which the grower entrusted the marketing of his fruit after it had been packed and placed in the car. More than 110 of these packing associations have joined together in this manner, and their business has increased from 20 per cent of the entire crop 12 years ago, to 40 per cent six years ago, and 60 per cent today.

The problem of distribution is fully as important as the problem of sale. Our crops are now so large, and the necessity of keeping our oranges and lemons before the entire consuming public is so great, that not only must the fruit be put into every possible available market, but the distribution must be even and continuous. Any other practice invites disaster. With the 110 packing houses operating through the exchange, each conducting its own business independently of the other, or with the 16 district exchanges of which the general exchange is composed, each operating independently of the other, bare markets at one point and overstocked markets at the same time in another would be the inevitable result. As it is now, with 60 per cent of the business in harmonious action, and knowing by experience about what the policy of the non-exchange shippers is, the distribution of its fruit by the exchange is conducted on a basis that assures far greater consumption at better prices than formerly when its percentage of shipments was smaller.

The organized selling force of the exchange throughout the country is one of its strongest features. This force is composed almost wholly of salaried agents, each giving his undivided attention to selling exchange oranges and lemons. This is in line with the policy of all up-to-date business enterprises, it being universally recognized that specialized service brings best results. Salaried salesmen in all important market centers is a distinctively exchange feature in citrus fruit marketing, and the exchange has 75 principal offices of its own in the United States, Canada and Europe, with over 200 salaried salesmen operating out of them, reporting sales and market conditions daily by wire.

The savings to the growers who sell their fruit through the exchange at the actual cost of operation with no profit to any individuals except the salaries that they get, run into astonishing figures when based upon the entire output of the state. Twenty million boxes of oranges and lemons have been produced in California the present season. One cent per box on this output amounts to $200,000. A few cents per box saved out of packers' profits, added to a few cents per box saved out of sellers' profits, amounts to several millions of dollars annually.

Newspaper advertising has been the greatest single factor in bringing about increased consumption of our oranges and lemons. From the experience gained through an initial expenditure of $10,000 in the first year of advertising in Iowa, and materially increased expenditures each succeeding year, with an appropriation of $100,000 for an advertising campaign that covers nearly the entire United States and Canada the present season, the exchange is now in a position to testify as to the complete success of its advertising methods. Three thousand newspapers scattered broadcast throughout the land are advertising regularly the superior merit of California citrus fruits and of California Fruit Growers' Exchange citrus fruits in particular. Such extensive publicity can only be obtained by the expenditure of a very large sum, but $100,000 means only four-fifths of a cent per box to exchange growers on this

year's shipments. As our crops increase, it will be necessary to extend this advertising in various other ways at greater cost, but with increasing shipments in the exchange this is entirely practicable at only slight expense to any grower. We feel confident in predicting that there is no danger of overproduction of good fruit if the growers unite in the advertising, distribution, and sale of their oranges and lemons after they have grown them.

In obtaining packing supplies, the savings that have been made through the operations of the Fruit Growers' Supply Company, which is owned by exchange growers, are something over a half million dollars per year, as compared with conditions that formerly prevailed. The supply company is now giving its attention to the purchase of fertilizers and other orchard supplies, with a probable ultimate saving in sight which will equal or exceed what has already been done with reference to packing house supplies.

It might be of interest to know that in six seasons the exchange sold for its growers 38,962,008 boxes of oranges and lemons, for which it received $69,873,137.45 net cash f. o. b. California, or an average of $1.79 per box for every box handled, with a loss of less than $6,000 for failure to collect during the entire period.

The contrast is clearly drawn between conditions in 1892 when disaster resulted from individual action in marketing a crop of only 4,000 cars, and fair prices this season, through co-operative marketing of 60 per cent of a crop of 50,000 cars of citrus fruits.

A summary of the benefits realized to the citrus fruit industry through organized co-operation is about as follows:

1. The cost of packing, as compared with 1892, has been reduced to all growers more than 10 cents per box; a saving of $2,000,000 annually on the present output.

2. The cost of selling has been reduced more than five cents per box in the same period; a saving annually of more than $1,000,000.

3. The orange freight rate has been reduced seven cents per box; a saving on the present output of more than $1,200,000 annually.

4. The lemon freight rate has been reduced 21 cents per box; a saving on the present output of more than $500,000 annually.

5. Through reduction of refrigeration cost, the growers will finally save $500,000 annually by the recent decision of the Interstate Commerce Commission.

6. The cost of orchard supplies, particularly fertilizers, is being materially reduced through the operations of the Growers' Supply Company, with ultimate savings of $500,000 in sight.

7. Through extended advertising, the consumption of citrus fruits has been increased to keep pace with production, thus avoiding disastrous results in years of large crops, insuring to the grower a fair price for his product, while the consumer is obtaining his oranges and lemons cheaper than ever before.

The conclusions to be drawn as to future action are self-evident. The growers must be alive to their own interests at all times. They must absolutely control their own business and stand unitedly together in these great problems, such as advertising, distribution, and marketing, as well as in many other ways. Various interests are opposed to their success, and are present with plausible arguments, all based on the perfectly natural desire for private gain on the part of those who make them. With a falling off of membership in the exchange, disaster to the industry would be invited, while, on the other hand, with a constantly increasing percentage of the crop to handle, it will be possible for the exchange to confidently plan for successful future operations with the maximum of benefit to the industry and to the state, as well as showing to the world what can be done by a united body of intelligent producers through persistent organized co-operative effort.

Pomological Points — While the chief activities in the California citrus industry are commercial, as indicated, pomological points are receiving systematic attention. The types of orange and

lemon varieties which best suit our growing conditions and trade requirements are quite definitely agreed upon. All the varieties which are being largely planted can be counted upon the fingers of one hand, including the Navel and Valencia for oranges, and the Eureka for a lemon—leaving two more fingers to be occupied by half a dozen minor varieties to be individually or locally contended for. It is, however, quite clear that there is a great chance for advantage in selecting variations superior in form, quality, productivity, etc., within the types, thus securing varieties which may be in many ways better than those now generally grown. The relative desirability of different stocks is also being observed in plantations made for the purpose, and the choice of buds is included. The California Experiment Station at its branches in Riverside and Whittier and in general citrus orchard studies has several experts constantly at work. The Bureau of Plant Industry of the Department of Agriculture also has men continually employed in California. It will naturally require several years to reach trustworthy conclusions in these lines.

E. J. Wickson

California Fruit Growers Exchange. See *Marketing*.

Canada

With the exception of Alaska, Greenland, Newfoundland and the two islands of St. Pierre and Miquelon, all of the northern half of the American continent is comprised in the Dominion of Canada. The area in square miles is 3,729,656.

The four principal surface divisions are:

1. The Appalachian region, forming the extreme southeastern corner.

2. The Laurentian Plateau or peneplain with its fringe and outliers of lowlands around the lakes and the Hudson bay, comprising the remainder of the eastern half of Canada

3. The great Central Plain.

4. The mountain regions of the West.

Each of these divisions represents, on the whole, a different geological formation, and has its own peculiar physical features.

The Appalachian region is the northeastern extremity of a system of mountains that were pushed up from the southeast against the Archaean or Laurentian area. Nova Scotia is a part of this system, and is one of the fruit growing regions of Canada. The Laurentian Plateau or peneplain is a slight elevation of tableland resting on hard crystaline rocks everywhere scored by glaciers that created basins in which the water settled, forming lakes. The land surface is sparsely covered with soil on which grow pine, spruce and other northern trees, except in the higher altitudes, where mosses and lichens grow.

South of the Laurentian Plateau is a valley of lowlands along the St. Lawrence river. This is the great fruit growing region of Quebec, while the strips of land that skirt the Great Lakes system are the main fruit growing regions of Ontario.

The most important fruit regions of Canada are thus surrounded in whole or in part by bodies of water that modify the temperature and protect from freezing, making it possible to grow fruit at a greater distance north than it would be possible without the lakes, the ocean or other bodies of water. The Atlantic ocean and the Bay of Fundy protect parts of Nova Scotia. The Great Lakes protect part of Ontario and the Pacific ocean protects the western portion of Canada.

The Central Plain is of vast extent, reaching from the Arctic ocean south to the Gulf of Mexico, so that only a portion of this formation lies in Canada. There is very little fruit grown in this region north of the line which divides the United States and Canada, and practically none is grown for commercial purposes.

The fourth great division or mountain belt lies west of the mountains which extend from Tierre del Fuego at the extremity of South America up through the United States and Canada and to the farthest western point of Alaska.

Granville Lowther

The Fruit Divisions of Canada

To assist in estimating the marketable crop the fruit districts of the Dominion are divided as follows:

District No. 1—Counties north of Lake Erie and Niagara district.

District No. 2—Counties on Lake Huron and inland to York county.

District No. 3—Counties bordering on Lake Ontario north to Sharbot lake and Georgian bay.

District No. 4—Ottawa and St. Lawrence valleys to Lake St. Peter and Southwestern Quebec.

District No. 5—New Brunswick with Northeastern Quebec.

District No. 6—Hants, Kings, Annapolis and Digby counties, Nova Scotia.

District No. 7—Nova Scotia not included in District 6.

District No. 8—Prince Edward island.

District No. 9—Lower mainland and islands, British Columbia.

District No. 10—Inland valleys, British Columbia.

Districts Nos. 1, 9 and 10 ship the commercial crop of peaches and other tender fruits.

Districts Nos. 1, 2, 3, 6, 9 and 10 grow plums, pears and winter varieties of apples for long distance markets and export.

District No. 4 ships Wealthy, Fameuse, Alexander and McIntosh Red apples.

Districts Nos. 5 and 7 will not produce sufficient winter fruit for home consumption.

"F.," "L.," "M.," and "F.-C.," which appear below, are abbreviations of "Failure," "Light," "Medium" and "Full Crop," respectively, as used by our correspondents in their monthly crop reports. A combination such as "M.-F.-C." means that about an equal number of correspondents reported "Medium" and "Full Crop."

Those who would get full value from the fruit crop reports, would do well to study closely the nature of the crop in each of these districts.

District No. 1—Grows a large quantity of apples of good size, fine color and excellent quality. Their one defect is that frequently even the winter varieties ripen so early in the fall that they deteriorate very materially before the cold weather of the early winter sets in and, therefore, unless they are placed in cold storage as soon as they are matured they are apt to show a large amount of waste if any attempt is made to keep them during the winter months. The apples, therefore, in this district must, for the most part be regarded as fall and early winter varieties, unless cold storage facilities are provided to enable the holding of them for winter shipping stock. Consequently, if it should appear that there was a large crop in District No. 1, it would not materially affect the quantity of winter shipping apples, but would be counted in with the fall and early winter apples of the other districts. To this we might make the possible exception of such varieties as the Ben Davis, Stark and similar varieties that are very little grown in this district.

District No. 2—Grows excellent winter apples. It is far enough north, or the elevation above the sea level is such, that the winter varieties like the Greening, Baldwin, Spy and Russet, ripen just as the early winter sets in; consequently, these varieties may be picked and stored with advantage, as winter shipping apples in ordinary storage.

A very marked peculiarity of the district is that orchards, though numerous, are small. The district is a very large one and apples can be grown to perfection in any part of it; but the farmers are engaged, for the most part, in mixed farming.

At three or four points selling associations have been formed, and wherever these have been organized apple growing is exceedingly profitable.

District No. 3—Grows an equally good quality of winter apples; but the orchards are larger and the fruit growers are taking better care of them. Pruning, spraying and cultivating are common. The varieties planted are fewer in number and

confined almost exclusively to winter apples.

Another significant feature that must be taken into account in future apple reports is that planting is being done quite freely in District No. 3. The number of young trees under 10 years old probably equals the present plantings. Consequently, each succeeding year there will be a large addition to the aggregate of the crop coming from District No. 3 as the result of new orchards coming into bearing. There will be a tendency, therefore, to underestimate the crop from this district on this account.

District No. 4—This district has a large quantity of apples of the Fameuse and Wealthy type. The climate is too severe for the standard winter varieties grown in Ontario. The varieties, such as the McIntosh Red, Wealthy, Wolfe River and a number of other hardy varieties, are all fall and early winter apples. In estimating the apple crop, therefore, consideration must be given to this fact, that a large crop of apples in District No. 4 will materially affect the market only during the fall and early winter months, and even in such cases the apples grown in this district are more desirable for dessert purposes than for cooking purposes. They, therefore, occupy a special position in the market.

District No. 5 has comparatively few trees. The quantity of fruit raised here is not enough for home consumption, so that it need scarcely be taken into consideration in an estimate of the crop for commercial purposes. This district includes New Brunswick. The possibilities of orcharding in the St. John valley are so great that there is a probability in the future of having to make a separate division of this part of District No. 5 to secure greater accuracy in the estimate.

District No. 6 is an exceedingly important one in apple production. It includes the four counties of Hants, Kings, Annapolis and Digby in Nova Scotia. It would be quite possible, considering the high state of cultivation in which a large number of the orchards are kept, to have a surplus of 500,000 or 600,000 barrels for export.

It will be readily seen that this is a very important fruit district in estimating the marketable crop for any particular year. The Gravenstein forms the largest bulk of their earliest shipments. This variety, however, is being less planted, and the district is becoming more and more confined to the winter shipping varieties. The Blenheim Orange type appears to flourish here better than the varieties so successful in Districts Nos. 1, 2 and 3. These are extremely popular in the English market, and, therefore, are always likely to be in good demand.

District No. 7 embraces the rest of Nova Scotia not included in District No. 6. A few isolated and protected valleys, particularly in the counties of Lunenburg and Digby, are demonstrating their capacity for growing fruit in commercial quantities; but as a whole it may be said that there is not enough winter fruit grown for home consumption, nor is there sufficient quantity to affect appreciably any results obtained from the other divisions.

District No. 8 includes Prince Edward island. There is a small quantity of early fruit grown here for export, which may increase somewhat in the near future, but is not enough at present to appreciably affect the market. This district still imports winter fruit for home consumption.

District No. 9 includes the valley of the Fraser from Lytton southward, the lower coast line and the Island of Vancouver in British Columbia. This is a mild and moist climate, favorable to fruit growing, which is carried on under very different conditions from those prevailing in District No. 10.

District No. 10 includes the interior valleys of British Columbia, which have a comparatively dry, warm climate. Irrigation is required in many of these valleys, and it is, therefore, desirable that they should be grouped together, inasmuch as, though they differ among themselves slightly, yet, for commercial purposes, the fruit is similar.

Districts Nos. 9 and 10 will become in the near future much more important factors in estimating the total crop of the Dominion.

A. C. McNeill,
Chief, Fruit Division.
J. A. Ruddick,
Commissioner.

Department of Agriculture, Fruit Division, Canada.

Fruit Growing in British Columbia

Fruit growing in British Columbia is subject to most of the conditions that prevail in the northwestern part of the United States. It is farther north and, where there is no protection from the coast breezes, the temperature is colder, and, therefore, in the unprotected regions, fruits cannot be successfully grown for commercial purposes. However, there are sections where the very finest qualities of winter apples may be grown commercially, and the lands in these districts are destined to be of great value. We quote the following from W. E. Scott, of the Department of Agriculture, Victoria, B. C.:

The Province may be roughly divided for horticultural purposes into four types or sets of conditions, which are briefly described.

District No. 1—Southern half of Vancouver island and adjacent islands, with a rainfall of approximately 30 inches. This district is very well adapted for all small fruits, and is par excellence a pear country. The earlier varieties of apples and a few winter kinds do very well, also the preserving varieties of cherries. Plums, prunes and sweet cherries also yield enormous crops.

District No. 2—Lower mainland, with a rainfall of approximately 60 inches. This is essentially a district suited for small fruits and dairying. In some parts, apples and pears do well, but only those which are least susceptible to scab should be planted.

District No. 3—The interior valleys of the Province, where irrigation is necessary. These valleys are noted for the excellent quality of apples which they grow. Peaches are also grown commercially, and are successful in some parts. Pears and other fruits do well, but I would emphasize these districts particularly for apple growing.

District No. 4—Interior valleys where irrigation is not necessary. Some of the valleys in the interior of British Columbia grow an excellent quality of fruit without irrigation, though, as a rule, better results can be obtained, if water is available when required. In the Kootenay valley the quality of the fruit is excellent, and it is also noted for its long-keeping quality.

Leading Commercial Varieties Grown in British Columbia

Apples—Yellow Transparent, Duchess of Oldenburg, Wealthy, Gravenstein, McIntosh Red, Jonathan, Spitzenburg, Yellow Newtown Pippin, Northern Spy, Wagener, Rome Beauty, Golden, King of Tompkins County.

Pears—Bartlett, Louise Bonne de Jersey, Dr. Jules Guyot, Beurre Clairgeau, Beurre d'Anjou, Flemish Beauty, Beurre Hardy, Winter Nelis.

Crab Apples—Transcendent, Hyslop.

Cherries—(Sweet) Royal Ann, Bing, Lambert, Winsdor; (Preserving) Olivette and English Morello.

Plums—Peach Plum, Bradshaw, Quackenboss, Grand Duke, Black Diamond, Pond's Seedling, Yellow Egg, Italian Prune.

Peaches—Triumph, Alexandra, Yellow St. John, Early Crawford, Elberta, Belle of Georgia.

Strawberries—Magoon, Sharpless, Paxton, British Queen, Royal Sovereign.

Raspberries—Cuthbert.

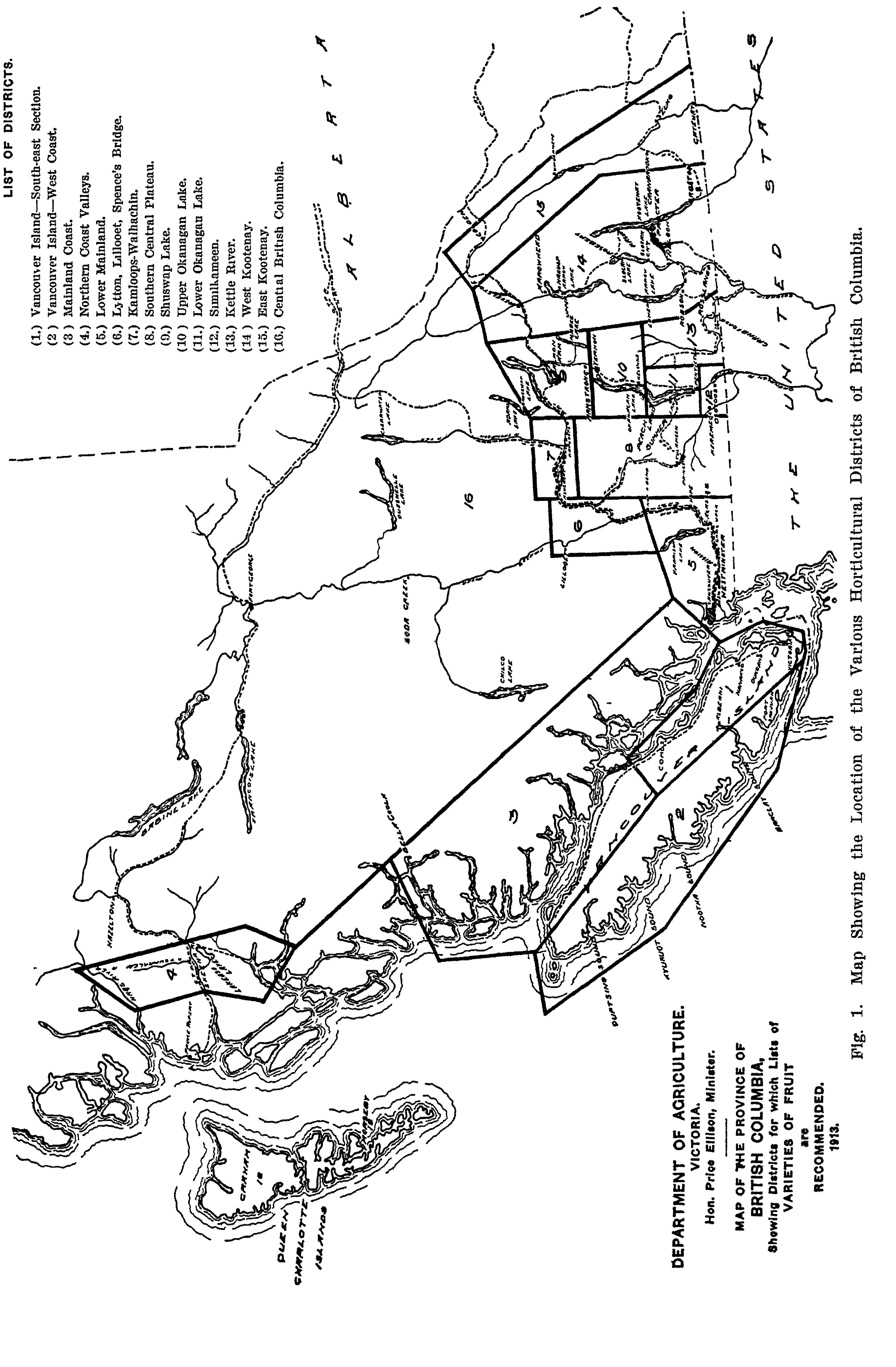

Fig. 1. Map Showing the Location of the Various Horticultural Districts of British Columbia.

Varieties of Apples Recommended for the Various District in British Columbia

DISTRICTS

1	5	6	7	9	10	11	12	13	14
King (1) 3,000, B	King (1) 2,000, B	Grimes (1) 1,000, E	Grimes (1) 500, D	Spy (1) 2,000, E	Wealthy (1) 12,000, D	Jonathan (1) 6,000, A	McIntosh (1) 600	Wealthy (1) 2,000 B	Wealthy (1) 2,000, D
Wealthy (2) 4,000, A	Wealthy (2) 1,500, E	Jonathan (2) 1,200, A	Jonathan (2) 700, A	Russet 2,000	Crabs (2) 42,000, E	Wagener (2) 4,000, C	Jonathan (2) 1,800, A	McIntosh (2) 2,500, C	Wagener (2) 4,000, A
Duchess (3) 1,500	Spy 3,000, A	Spitzenburg 1,200, B	Spitzenburg E	Pewaukee 2,300	McIntosh (3) 24,000, C	Spitzenburg 3,000, B	Wagener (3) 1,500, E	Jonathan (4) 5,000, A	McIntosh (3) 3,000, C
Spy 1,000, C	Blenheim	Spy 1,000, D	Winesap (3)	Ben Davis 1,200	Jonathan (4) 30,000, A	Y. Newton (3) 2,500, D	Spitzenburg (4) 800, B	Wagener 800	Spy (4) 1,500, E
Blenheim (4) 1,000	Jonathan	Ben Davis 1,500, C	Rome Beauty	Wealthy (2) 2,800, D	Wagener 20,000, B	Cox Orange 2,000, E	Newtown (5) 1,000, C	N. Spy (3) 1,500, D	Spitzenburg 600
Ribston 800	Ben Davis 2,000, C	Winesap (3) 2,000, F	Wealthy (5) C	Wagener (3) 1,200, A	Spitzenburg 10,000, G	Grimes (4) 1,000, F	Baldwin 1,500	Spitzenburg 600, E	Jonathan (6) 3,000, B
Baldwin 1,500, D	Baldwin 3,000, D		McIntosh (4) B		Spy (5) 6,000, F	Wealthy 3,000	Winesap (6) 1,000, D	Newtown 1,200, F	Newtown 800
	Grimes (3) 1,000, F		Wagener F	McIntosh (4) 1,200, C	Y. Newtown 8,000	Crabs 1,500	Bellflower 1,500	Rome Beauty 800, G	Gravenstein (5) 1,500, F
				Jonathan (5) 2,500, B	Cox Orange 5,000	Winesap 1,800, G	Ben Davis 1,800	Delicious 400	King 400
					Ben Davis 7,000	Rome Beauty 600		Winesap 1,200	Baldwin 1,000, G
Total cars. 40	30	15	10	45	450	100	25	45	70

1. The figures in parenthesis, (1), (2), etc., indicate varieties being most successfully grown.
2. Quantity produced, *in boxes*. Official figures not yet available, but above will be found reasonably accurate.

Note. Estimate in cars includes many other varieties.

3. Letters give varieties in order of number of trees planted.

Export Fruit Packages, Etc., in British Columbia
Inside Measurements.

	Size of Box, etc., Inches	Average Weight (Net)	Remarks
Apples	10 x 11 x 20	41 lb.	
Crab Apples	10 x 11 x 20 (apple)	50 lb.	The half apple box is also used on the Lower Mainland.
	18¼ x 11 x 8½ (pear)	40 lb.	As used in Upper Country; half pear box and peach box (20 lb.) also sometimes used.
Pears	18¼ x 11 x 8½	46-48 lb.	
Peaches	18¼ x 11¾ x 4	17-21 lb.	
	18¼ x 11¾ x 4¼		
	18¼ x 11¾ x 4½		
Plums	15¾ x 15¾ x 4¼	20-22 lb.	4-basket crate.
Prunes		20-25 lb.	Shipped largely in peach boxes.
Apricots	15¾ x 15¾ x 4¼	19-20 lb.	4 basket crate.
Cherries	18½ x 9 x 2¼	8½-9 lb.	Sour cherries (4-basket crate), equals 16-18 lb. Sour cherries (special pack), equals 24 lb.
Raspberries	2-5 quart carton (24 to 1 crate); size of carton, 5¼ x 5¼ x 1	14 lb.	Size of crate, 16¾ x 23¼ x 5¼.
Strawberries	4-5 quart carton (24 to 1 crate); size of carton, 5⅞ x 5¼ x 8	24 lb.	Size of crate, 16¾ x 23¼ x 6¾.
Loganberries	2-5 quart carton (24 to 1 crate)	16 lb.	
Currants			As for strawberries.
Grapes	6-quart basket (approximately)		Six 6-quart baskets reckoned as 100 lb. by the Express Co.
Rhubarb	20 x 15¾ x 7¾	40 lb.	
Cantaloupes	12 x 11½ x 20¼		
Tomatoes	18¼ x 11¾ x 5	23 lb.	
Cabbage	25 x 23 x 18		
Lettuce	28¼ x 16 x 12		

Horticulture in Nova Scotia

The horticultural industry of Nova Scotia is generally supposed to be carried on chiefly in a small section of the western part of the Province. While it is true that the present production of orchard fruits is largely confined to the Annapolis, Cornwallis and adjacent valleys, there are many other parts of the Province where these fruits can be grown, and where small fruits and market garden crops can be as successfully grown as in the so-called orchard district. The nearness of many of these places to mining towns and manufacturing centers gives them the advantage of a local market where fresh garden products find a ready sale at good prices. In such localities intensive methods on small areas often bring surprisingly large profits. Strawberries and bush fruits, asparagus, beans, celery, lettuce, rhubarb, peas, tomatoes, roots and early potatoes are some of the crops which have been found profitable in this kind of farming. It is probable that a history of horticulture written for the Province a quarter of a century or more hence will have to include a large reference to this industry in these other counties. But, in the meantime, fruit growing is developed to such a greater extent in the Annapolis valley that these articles, more especially insofar as they are historical, apply largely to this part of the Province. If, however, the same principles which have made fruit growing in Kings and adjoining counties successful were applied in the other counties of the Province, the industry would become much more extensive than at present. The following articles are accordingly commended to all citizens of Nova Scotia, whether living

within or without the Annapolis and nearby valleys.

For the last 30 years the production of fruit from the orchards of Nova Scotia has been steadily increasing. The yearly income from the sale of fruit exported now amounts to about $1,500,000. Considering the number and extent of the young orchards just coming into bearing, there seems every reason to believe that the future rate of increase will be still more rapid, and that the annual returns for the years immediately succeeding 1910 will probably exceed $2,000,000. The business of fruit growing in Nova Scotia offers an opportunity for the investment of capital as safe as that afforded by any business in the Province.

The best fruit growers are constantly trying to understand and to reduce to practice the principles of horticultural science. With these men annual cultivation of orchard lands is the rule. Cover crops are grown. Stable manure, commercial fertilizers, or both, are yearly applied. Fruit trees are so pruned as to admit the air and sunlight to the growing fruit, to remove weak and dying or interfering branches and to encourage and maintain a healthy, continuous growth of the tree. Three or more sprayings with a poisoned fungicide are given each year to control insect pests and fungous diseases. Formerly Bordeaux mixture was the only fungicide used, but lately the lime-sulphur wash has been tried by some of the best orchardists with apparently good results. This mixture was first brought into use in orchards to combat the San Jose scale. It was soon found, however, that, besides being an insecticide, it had an important fungicidal value and, though the dreaded scale has not yet made its appearance in Nova Scotia, the lime-sulphur wash is being used both as a dormant and a summer spray.

It is important to notice that in starting an orchard the returns are far more remote than in other lines of farming. Under the ordinary method of treatment, an apple orchard gives little, if any, income during the first 10 years. There is, however, an annually accruing value in the growth of the trees, which more than offsets the expenses incurred in their care. Almost all the bearing orchards in the fruit district today were grown while the owners were engaged in other kinds of farming. But when the profits of orcharding became apparent, this branch of agricultural industry took first place. While other lines of farming are now secondary to orcharding in the fruit district, they are nevertheless of considerable importance in providing a source of income until the young orchard comes into bearing, paying expenses during years of poor crops or low prices, or providing a means for using the product of natural hay lands, and thus supplying manure for the orchard. The raising of small fruits, market gardening, dairying, beef or poultry raising, or other branches of agriculture to which the farm may be best suited, provides an excellent side line to orcharding.

In years of ordinarily good crops of fruit, about seven-eighths of the marketable apples produced in Nova Scotia find a sale in foreign countries. The chief market is in Great Britain, although there is now a growing trade with Newfoundland, the West Indies, and South Africa. Our proximity to the British market and the comparative cheapness of water transportation give Nova Scotian growers an advantage over their competitors. The varieties of apples generally grown in England are found to succeed well here, and our growers aim to secure such varieties as are popular with the British consumer.

The fruit industry, however, has now reached a stage in which the proper varieties of trees to plant, the proper care of the growing trees, and the handling of the fruit are fairly well understood. The next step in the natural development of the industry is now being taken in the formation of co-operative associations of fruit growers for the marketing of fruit. The proper marketing is as important as the growing of fruit. Without organization the producers are at the mercy of the transportation companies and of deal-

ers at home and abroad, who are generally understood to be combined and well organized. The result is that the amount received by the producer of the fruit is often less than half the amount paid by the consumer. To secure their share of the return from the industry, the producers must be as well organized as are the men with whom they deal. Ten co-operative associations have already been formed in the fruit-producing district of Nova Scotia, and the organization of these into one central association has now been effected.

The following articles from successful horticulturists give some idea of the profit derived from orcharding and gardening in Nova Scotia. They also, to an extent, describe the methods by which these results have been obtained. While not by any means exhaustive in their treatment of the subject, they touch upon all the operations of importance in connection with fruit growing, and will be found instructive, suggestive and most encouraging.

P. J. SHAW,

(Annual Report Secretary of Agriculture, N. S., 1910.)

Export Figures from 1880 to 1910

1880-1885	23,920
1885-1890	83,249
1890-1895	118,552
1895-1900	259,200
1900-1905	330,406
1905-1910	482,298

The prices have ranged at from $2 to $2.25 per barrel.

Fifty Per Cent Increase

From the above figures we observe that the average export of the last five years has been over 20 times that of the same period 25 years ago. Also that, though the increase for the first 10 years of our export business was greater than the last 10 years, yet the increase for the last three five-year periods has been approximately even, and shows the export of each period to be about 50 per cent more than the previous one. Four periods out of the six show approximately this increase.

It is estimated by the railway authorities that during the last few years quite 150,000 barrels per year have been consumed in the Province, which should be added to the above 482,298 to show our actual production during the last five years. There is little doubt that the quantity used in our Province during the last 15 years has increased in equal proportion to our export.

RALPH S. EATON,
Kentville, N. S.

(In Annual Report of Secretary of Agriculture, N. S., for 1910.)

FRUITS OF ONTARIO

When the first fruit trees were planted in Ontario, probably about 150 years ago, the settlers had no reliable information to guide them in selecting varieties or in caring for the trees after they were planted. But the experience of these early settlers was taken advantage of by their descendants who, with the additional knowledge possessed, were able to make some progress, although scattered as they were in those early times without good means of intercourse. The dissemination of information from one to another and to the new settlers who were coming in was slow until the railways were built. Then fruit growing became much more general, as trees could be easily transported from one part of the Province to another. In 1859 a few enthusiastic horticulturists organized the Ontario Fruit Growers' Association. Meetings were held in different parts of the Province, and the people were urged to plant more fruit. This organization has, for the past 47 years, by its meetings, annual reports, the *Canadian Horticulturist*, and in many other ways, done very much to bring about the present development in the fruit industry of Ontario. Realizing that more definite information was needed to guide fruit growers in the planting of varieties and the culture of fruits, the association in 1893 urged upon the government the importance of establishing fruit experiment stations throughout the Province. The idea received the approval of the government, and in 1894 four stations were established, this number being increased to 13 in the course of a few years. To these were sent many varieties of fruits, which were tested and

reported upon each year by those in charge of the stations. As these experimenters were all practical fruit growers, and in most cases had made a specialty of some kind of fruit, much valuable information regarding varieties and their culture was accumulated by the department of agriculture.

Tree Fruits

Among what are commonly classed as the tree fruits are the apple, cherry, peach, pear, plum and quince.

The importance of the fruit interests may be fairly judged by the following figures for Ontario from the Dominion census of 1901:

	Not Bearing	Bearing	Total Trees	Bushels	Value	Acres	Capital Value
Apple Trees.... ...	1,989,983	7,551,636	9,541,619	13,631,264	$3,407,815	228,013	$34,201,950
Peach Trees.......	470,772	811,725	1,282,497	539,482	539,482		
Pear Trees.........	280,175	564,798	844,973	487,759	365,819	38,002	11,400,600
Plum Trees.......	686,628	999,091	1,685,719	337,108	252,831		
Cherry Trees......	237,792	446,556	684,348	132,177	297,398		
Total.........	3,665,350	10,373,806	14,039,156	15,127,790	4,863,345	266,015	45,602,550

There has been a marked increase in the number of acres planted since the 1901 census was taken, the total number of apple trees, according to the last report of the Ontario Bureau of Industries, being 10,201,766.

THE APPLE

From the Ottawa river, which bounds the Province on the east, to the Great Lakes on the west, a distance of about 500 miles, and from the St. Lawrence river and Great Lakes on the south to latitude 45 degrees, and even 46 degrees, on the north, a distance of about 280 miles, there are many flourishing commercial apple orchards. These produce annually an average crop of about 35,000,000 bushels of fruit. But apple growing is not confined even to this area, for scattered here and there over the newer parts of Ontario almost up to the Manitoba boundary are trees which are bearing good apples and supplying the settler with fruit for home consumption.

Owing to the material difference in climatic conditions between the extreme southern and the northern parts of the Province, some varieties of apples are more adapted to certain sections than others, not only on account of their varying degrees of hardiness, but because some kinds produce better fruit in certain sections than in others. Furthermore, as apples grown in the southern parts of the Province do not keep as well as those grown in the northern sections, the fruit matures earlier, and hence does not come into keen competition with, perhaps, the same varieties from other sources. Each part of the Province, therefore, where apples are grown can produce fruit which has a fair chance of commanding the highest price on the market. As these climatic conditions cannot be changed, it behooves fruit growers in the southwestern peninsula to make a specialty of growing fruit for the early markets, for there is no other section which can compete so favorably in the production and sale of early apples, especially for the rapidly growing market in the Northwest.

Varieties Recommended

General Lists—After testing a large number of varieties of fruit at the various fruit stations, the board of control has decided upon the following as the most desirable for general planting.

District Lists—The district lists given by the various experimenters show vari-

eties especially adapted to the sections represented by their stations.

The term *Commercial* is intended to include the varieties most desirable for market purposes, and the term *Domestic* those most desirable for home uses, either cooking or dessert.

These lists are given, as far as possible, in the order of ripening.

It is realized that there are many varieties not included in these lists which may do well *under special conditions*, yet which are generally not considered as desirable as those mentioned.

General List of the Most Valuable Varieties for Market Approved by the Board of Control

Summer

ASTRACHAN—Adapted to all sections except the extreme north.

DUCHESS—Adapted to all sections.

Fall

GRAVENSTEIN—Adapted to all sections except the St. Lawrence river and other northerly portions of the Province.

WEALTHY — Particularly valuable for northern sections.

ALEXANDER — Especially for northern districts.

MCINTOSH—Adapted especially to the St. Lawrence river district, but can be grown over a much wider area.

FAMEUSE—Adapted especially to the St. Lawrence river district, but succeeds well over a much wider area.

BLENHEIM—Adapted to all sections except the St. Lawrence river district and northerly portions of the Province.

Winter

KING—Adapted only to the best apple sections, and succeeds best when top grafted on hardy stocks.

HUBBARDSTON — Adapted to the best apple sections.

GREENING—Adapted to the best apple sections.

BALDWIN—Succeeds best on clay land, and is adapted to the best apple districts.

SPY—Adapted to the best apple districts, but can be grown with success farther north by top-grafting on hardy stocks. This is also a good method of bringing it into early bearing.

ONTARIO—An early and abundant bearer, but short-lived. Recommended as a filler among long-lived trees. Adapted to same districts as Northern Spy, which it somewhat resembles.

STARK—Adapted to best apple districts.

Varieties Especially Adapted to Home Use

Summer

TRANSPARENT—Adapted to all sections.

PRIMATE—Adapted to best apple sections.

SWEET BOUGH — Adapted to best apple sections.

DUCHESS—Adapted to all sections.

Fall

CHENANGO—Adapted to best apple sections.

GRAVENSTEIN—Adapted to best apple sections.

WEALTHY—Especially adapted to northern sections.

MCINTOSH—Especially adapted to northern sections.

FAMEUSE—Especially adapted to northern sections.

BLENHEIM—Adapted to best apple sections.

Winter

KING—Adapted to best apple sections. Should be top-grafted.

WAGENER—Adapted to best apple sections.

SWAYZIE—Adapted to all sections except most northerly.

GREENING—Adapted to best apple districts.

TOLMAN—Adapted to best apple districts.

SPY—Adapted to best apple districts, but will succeed farther north if top-grafted.

MANN—Adapted to best apple districts, but will succeed farther north if top-grafted.

Hardy Varieties Recommended for Sections North of Latitude 46 Degrees

Summer

Yellow Transparent, Charlamoff.

Fall and Winter

Duchess, Wealthy, Hibernal, Longfield, Patten, Whitney, Hyslop, Scott Winter.

Crabs Suitable for the Whole of the Province

WHITNEY—A large crab of high quality, suitable for planting in the extreme north where other apples will not succeed. May be used for dessert or cooking.

MARTHA—An early crab of fair quality.

TRANSCENDENT—Yellowish crab, season early autumn.

HYSLOP—Dark, rich red crab, of late season, quality only fair.

District Lists Recommended by the Experimenters

Niagara District

LINUS WOOLVERTON

Grimsby, Ont.

COMMERCIAL — Astrachan, Gravenstein, Duchess, Alexander, Blenheim, Cranberry Pippin, Hubbardston, King, Greening, Baldwin, Spy.

DOMESTIC—Early Harvest, Gravenstein, Sweet Bough, Chenango, Duchess, Shiawassee, Fall Pippin, Fameuse, Swayzie, Wagener, Yellow Bellflower, Spitzenburg, Tolman.

Bay of Quinte District

W. H. DEMPSEY

Trenton, Ont.

COMMERCIAL — Duchess, Gravenstein, Trenton, Alexander, Wealthy, Fameuse, McIntosh, King, Greening, Baldwin, Ontario, Seek-no-Further, Spy, Tolman, Ben Davis, Stark.

DOMESTIC — Benoni, Primate, Gravenstein, Fameuse, McIntosh, Grimes, Greening, Ontario, Spy, Tolman, Swayzie.

Burlington District

A. W. PEART

Burlington, Ont.

COMMERCIAL — Astrachan, Duchess, Wealthy, Ribston, Blenheim, King, Greening, Baldwin Spy.

DOMESTIC — Astrachan, Sweet Bough, Gravenstein, Wagener, Seek-no-Further, Golden Russet.

Lake Simcoe District

G. C. CASTON

Craighurst, Ont.

COMMERCIAL—Duchess, Peerless, Alexander, Wolf River, Blenheim, Pewaukee, Stark, and the following if top-worked on hardy stocks: Greening, King, Ontario, Baldwin, Spy.

DOMESTIC—Astrachan, Primate, St. Lawrence, Fameuse, McIntosh, King, Spy.

Lake Huron District

A. E. SHERRINGTON

Walkerton, Ont.

COMMERCIAL — Astrachan, Duchess, Wealthy, Fameuse, McIntosh, Blenheim, Greening, Baldwin, Spy, Golden Russet, Ben Davis.

DOMESTIC — Transparent, Astrachan, Duchess, McIntosh, Grimes, Blenheim, King, Spy, Golden Russet.

St. Lawrence District

HAROLD JONES

Maitland, Ont.

COMMERCIAL—Duchess, Alexander, Wolf River, Scarlet Pippin, Fameuse, McIntosh, Baxter, Milwaukee, Golden Russet.

DOMESTIC — Transparent, Brockville, Beauty, Scarlet Pippin, Fameuse, McIntosh, Blue Pearmain, Golden Russet, Yellow Bellflower.

Algona District

CHARLES YOUNG

Richard's Landing, Ont.

COMMERCIAL AND DOMESTIC—Astrachan, Transparent, Duchess, Charlamoff, Gideon, Longfield, Wealthy, Scott Winter.

THE PEAR

The pear succeeds all over the best apple districts of Ontario, but few good hardy varieties have yet been found, hence the commercial culture of the pear does not extend as far north as the apple. The principal pear orchards are found in Southern Ontario. There are many good orchards, however, along Lake Ontario as far east as the Bay of Quinte and north to the Georgian Bay.

In Eastern Ontario, only a few kinds succeed, and these are not planted on a commercial scale. These hardy varieties are grown to a limited extent for home use as far north as latitude 45 degrees and some of the Russian pears, though inferior in quality and very subject to blight, may be grown still further north.

The pear stands distant shipment well if picked at the right time, and properly

packed and handled in transit, and hence larger quantities are being sent to distant markets every year, and as a rule good prices are obtained for the fruit.

Varieties Recommended

General List Approved by the Board of Control

COMMERCIAL—Giffard, Clapp, Bartlett, Boussock, Flemish (hardy, subject to spot), Howell, Louise, Duchess, Bosc, Clairgeau, Anjou, Kieffer.

DOMESTIC — Summer Doyenne, Giffard, Bartlett, Flemish (for the north), Sheldon, Seckel, Bosc, Anjou, Lawrence, Josephine, Winter Nelis.

District Lists Recommended by the Experimenters

Niagara District

LINUS WOOLVERTON
Grimsby, Ont.

COMMERCIAL—Chambers, Wilder, Giffard, Clapp, Bartlett, Hardy, Bosc, Howell, Louise, Duchess, Pitmaston, Clairgeau, Anjou, Easter Beurre.

DOMESTIC — Doyenne, Manning, Giffard, Boussock, Rostiezer, Marguerite, Sheldon, Seckel, Triumph, Ritson, Louise, Hardy, Diel, Anjou, Lawrence.

Burlington District

A. W. PEART
Burlington, Ont.

COMMERCIAL—Wilder, Clapp, Bartlett, Boussock, Louise, Duchess (dwarf), Anjou, Kieffer, Winter Nelis, Easter Beurre.

DOMESTIC — Wilder, Bartlett, Louise, Anjou, Winter Nelis.

Bay of Quinte District

W. H. DEMPSEY
Trenton, Ont.

COMMERCIAL AND DOMESTIC — Giffard, Tyson, Clapp, Boussock, Hardy, White Doyenne, Dempsey, Bosc, Clairgeau, Goodale, Lawrence, Josephine.

St. Lawrence District

HAROLD JONES
Maitland, Ont.

DOMESTIC—Clapp, Flemish, Ritson.

THE PLUM

The plum has a wider range over the Province of Ontario than the pear or peach, this fruit being a native of the Province and found as far north as Manitoba.

There are three large groups into which the plums may be divided here, namely, the European, Japanese, and American. In the European or domestica group are included most of the varieties which are grown in Ontario commercially. These plums are not as hardy as the natives, hence their profitable culture is limited to almost exactly the same districts as the pear, the commercial orchards being mostly found in Southern Ontario, the Georgian Bay District, and along Lake Ontario west of the Bay of Quinte. A few of the hardiest produce crops occasionally in Eastern Ontario and up to about latitude 45 degrees in Central Ontario, but they are too uncertain to be grown for profit.

The Japanese plums are grown over practically the same area as the European, but the fruit buds average a little more tender.

In the American group are included the Americana and Nigra plums, the former being derived from a hardy United States species and the latter from the native Canadian plum. The varieties of this group are quite hardy and can be grown commercially where the European and Japanese plums will not succeed, and while not so good in quality as the others, good prices are at present obtained for what are produced.

Plums are not being so extensively planted at present as other large fruits, since during recent years the markets have several times been glutted, resulting in low prices. The demand for plums is, however, always large, and the excellent market which is opening up in the Northwest will probably in the future prevent, in a great measure, this over-supply.

The cultural directions for the apple will apply in most particulars to the plum, which will succeed on almost all kinds of well drained soils, although it does best on the heavier clay loams. Trees one or two years of age should be planted about eighteen feet apart each way, the soil having been thoroughly

prepared beforehand. The trees should be severely headed back when planted, and future pruning will consist in forming a well shaped open head. As some varieties make exceptionally strong growth it is a good practice when the trees are young to prune the young growth back about one-half each spring to avoid splitting. When the trees begin to bear little pruning is necessary, as they usually bear so heavily that the trees do not make much growth annually.

Orchards should be kept thoroughly cultivated, and cover crops are recommended as for the apple, cherry, peach and pear. The fruit should be picked when it is well colored but still firm.

Varieties Recommended

General List Approved by the Board of Control

COMMERCIAL AND DOMESTIC—

AMERICAN—These are extremely hardy and are desirable where the European and Japanese varieties cannot be grown: Aitken, Cheney, Bixby, Mankato, Wolf, Hawkeye, Stoddard.

EUROPEAN—Bradshaw, Imperial Gage, Gueii, Shipper Pride, Lombard (liable to overbear, requires thinning), Quackenboss, Yellow Egg, Grand Duke, Coe, Reine Claude (one of the best for canning).

JAPANESE—These are apparently quite as hardy as the European varieties: Red June, Abundance, Burbank, Chabot, Satsuma (red fleshed, desirable for canning).

District Lists Recommended by the Experimenters

Lake Huron District

A. E. SHERRINGTON
Walkerton, Ont.

COMMERCIAL AND DOMESTIC—Red June, Ogon, Burbank, Bradshaw, Imperial Gage, Gueii, Shipper Pride, Victoria, Quackenboss, Yellow Egg, Monarch, Grand Duke, Satsuma.

Georgian Bay District

JOHN MITCHELL
Clarksburg

COMMERCIAL AND DOMESTIC—Red June, Burbank, Washington, Bradshaw, Imperial Gage, Quackenboss, Arch Duke, Diamond, Monarch, Yellow Egg, Coe, Satsuma, Reine Claude.

Burlington District

A. W. PEART
Burlington, Ont.

COMMERCIAL—

EUROPEAN—Bradshaw, Imperial Gage, Lombard, Yellow Egg, Glass, Reine Claude.

JAPANESE—Red June, Abundance, Burbank, Chabot, Satsuma.

DOMESTIC—Abundance, Saunders, Bradshaw, Imperial Gage, Smith Orleans, Lombard, Yellow Egg, Satsuma, Reine Claude.

Niagara District

LINUS WOOLVERTON
Grimsby, Ont.

COMMERCIAL—Red June, Burbank, Bradshaw, Chabot, Gueii, Coe, Quackenboss, Satsuma, Reine Claude.

DOMESTIC — Abundance, Washington, Yellow Egg, Shropshire, Quackenboss, Satsuma, Reine Claude.

St. Lawrence District

HAROLD JONES
Maitland, Ont.

DOMESTIC—

NOTE—*The European and Japanese varieties are only recommended for the home garden in the St. Lawrence District, as they have not proved entirely hardy nor very productive.*

AMERICAN—Milton, Whitaker, Hammer.

EUROPEAN—Gueii, Lombard, Shipper Pride, Glass.

JAPANESE—Red June, Burbank.

THE GRAPE

There is no more popular fruit than the grape, and, owing to the rapid increase in population during recent years, the demand for grapes is constantly growing. For this reason the planting of grapes, which was in a large measure suspended for a few years, is steadily increasing, many vineyards now being established annually.

The grape requires a comparatively dry hot season for the development of good flavor and the perfect ripening of the fruit, and as most of the cultivated varieties will not stand very low temperatures unless protected, the grape suc-

ceeds best in the most southern parts of the Province, the commercial vineyards being confined almost entirely to the Niagara peninsula, and to the district bordering Lake Erie. The grape can, however, be grown successfully over a much wider area than this, and where the summer temperature is fairly high and spring and early autumn frosts are rare, large quantities of grapes are grown for home consumption. Hence the early varieties of this fruit may be ripened pretty generally over the Province as far north as latitude 45 degrees and probably further.

Varieties Recommended

General List Approved by the Board of Control

COMMERCIAL AND DOMESTIC—

BLACK—Moore, Campbell, Worden, Concord, Wilder.

RED—Delaware, Lindley, Agawam, Vergennes.

WHITE—Niagara, Diamond.

FOR NORTHERN SECTIONS—

BLACK—Champion, Moore, Campbell, Worden, Wilder.

RED—Moyer, Brighton, Delaware, Lindley.

WHITE—Winchell, Diamond.

District Lists Recommended by the Experimenters

Wentworth District

M. PETTIT

Winona, Ont.

COMMERCIAL—

BLACK—Champion, Campbell, Worden, Concord.

RED—Delaware, Lindley, Agawam, Vergennes, Catawaba.

WHITE—Niagara, Diamond.

Niagara District

LINUS WOOLVERTON

Grimsby, Ont.

DOMESTIC—Moyer, Campbell, Worden, Delaware, Lindley, Brighton, Wilder, Agawam, Requa.

BUSH FRUITS

In Bush Fruits are included the Blackberry, Currant, Gooseberry, and Raspberry. These fruits, while not being of quite so much importance from a commercial standpoint as the tree fruits, are grown and consumed in very large quantities in Ontario, and as they are used in many ways by housekeepers there will always be a demand for them. They can be grown between the tree fruits to advantage while the latter are young and hence often augment the revenue of the fruit grower materially before the tree fruits come into full bearing.

Some idea of the large quantities of bush fruits which are grown will be obtained from the Dominion census statistics for 1901, where it is stated that there were at that time 8,116 acres devoted to small fruits in Ontario, on which were produced about 16,000,000 quarts valued at $811,000.00. The strawberry is included in the above estimate. The present area devoted to small fruits is estimated at 10,000 acres.

THE BLACKBERRY

The blackberry is not grown so largely in Ontario as it might be. It is one of the most profitable fruits to grow where it succeeds well, but as the crop is rather uncertain except in Southern Ontario and in localities farther north where it is protected by a deep snow fall, its range of successful culture is somewhat limited. Where there is not danger of winter killing, a well drained clay loam is probably the best for the blackberry, as it is cooler and more retentive of moisture than lighter soils. The blackberry must have plenty of soil moisture when the fruit is ripening, otherwise but little of the crop will develop. Further north, where hardiness is of greater consideration than conservation of moisture, the poorer and warmer soils are preferred, as the blackberry on these soils does not make as rampant a growth and hence ripens its wood better.

Varieties Recommended

General List Approved by the Board of Control

Agawam, Snyder, Eldorado, and for southern sections, Kittatinny.

District Lists Recommended by the Experimenters

Burlington District

A. W. Peart

Burlington, Ont.

Commercial and Domestic—Snyder, Briton, Triumph, Agawam, Taylor.

Lake Simcoe District

G. C. Caston

Craighurst, Ont.

Commercial and Domestic—Agawam, Eldorado.

THE CURRANT

The currant is a very hardy fruit and for this reason can be grown with success all over the Province of Ontario, and as fair results are obtained without high culture, almost everyone who has a garden grows currants. Like all other fruits, however, the currant becomes most profitable when it is given good care.

The currant is a moisture loving fruit, hence for profit it should be planted in a cool, moist, but well drained soil. It also requires rich soil, hence as a rule the best is a good clay loam which is retentive of moisture and cooler than sandy loam. The soil should be thoroughly prepared for currants before planting. One year old plants from cuttings if strong will give good satisfaction, although two year old plants are not too old. They should be planted in rows about six feet apart, and from four to five feet apart in the rows, the wide distance being more satisfactory for the strong growing varieties and especially black currants. Fall planting is best for currants, as the buds start very early in the spring and should these develop before they can be planted, their future growth will be checked. They can, however, be planted in the spring with success. The plants should be set a little deeper than they were in the nursery, and the soil well pressed against the roots. Thorough cultivation should follow to promote as much growth as possible, but it should be shallow, as the currant roots are near the surface. The following spring the currants will need some pruning to give them a shapely open head, the bush when well shaped having from five to seven main branches well distributed to avoid crowding. The fruit of red currants is formed from spurs on wood two years old, while the fruit of black currants is borne on wood of the previous year. Currants should be pruned annually to get the best results.

Varieties Recommended

General List Approved by the Board of Control

Black—Black Victoria, Champion, Lee, Naples, Saunders.

Red—Cherry, Fay, Pomona, Red Cross, Victoria, Wilder.

White—White Grape.

District Lists Recommended by the Experimenters

Burlington District

A. W. Peart

Burlington, Ont.

Commercial—

Black—Lee, Naples, Saunders.

Red—Cherry, Fay, North Star, Prince Albert, Victoria, Wilder.

White—White Grape.

Lake Huron District

A. E. Sherrington

Walkerton, Ont.

Black—Champion, Naples, Saunders.

Red—Pomona, Red Cross.

THE GOOSEBERRY

The gooseberry and the currant are the two hardiest bush fruits which are cultivated, and the gooseberry, like the currant, succeeds in all parts of the Province, although the hardy gooseberries are confined to the varieties derived from the native species and to crosses between the native and the European. The European varieties are only grown successfully in favored locations as in most places they are very subject to mildew.

The gooseberry, like the currant, requires a cool, moist, though well drained soil to give the best results, and suffers more than almost any other fruit in a dry time. These cool, moist conditions are best obtained as a rule by planting in a well drained friable clay loam. The soil should be thoroughly prepared, as although the gooseberry will give a fine crop of fruit, even if not well cared for,

the size will be small. Gooseberries may be planted with success either in spring or fall, but fall planting is preferable, as growth begins early and plants usually receive a severe check if planted in the spring.

Varieties Recommended

General List Approved by the Board of Control

Pearl, Downing, Red Jacket. Whitesmith is one of the best English varieties, but is almost valueless on some soils and in some localities owing to mildew.

THE RASPBERRY

Next to the strawberry, the raspberry is the most popular bush fruit grown in Ontario, and as it follows the former in season the consumer is well supplied with these two fruits most of the summer. The raspberry being a native of Ontario, is hardy in almost all parts of the Province, hence it is cultivated over a very wide area.

Like the other bush fruits, the raspberry does best when grown in a cool, moist, but well drained soil. While this soil should be of good quality, if it is very rich in nitrogen the growth may be too rank and in some localities the canes on this account are more liable to winter injury. The best success is usually obtained with a good clay loam, although the raspberry will do fairly well in most kinds of soil. The preparation of the land should be the same as for other bush fruits.

Varieties Recommended

General List Approved by the Board of Control

BLACK—Hilborn, Older, Gregg, Smith Giant.

PURPLE—Columbian, Shaffer.

RED—Marlboro, Herbert, Cuthbert.

WHITE—Golden Queen.

District Lists Recommended by the Experimenters

Lake Huron District

A. E. SHERRINGTON
Walkerton, Ont.

COMMERCIAL AND DOMESTIC—

BLACK—Hilborn, Conrath, Older.

PURPLE—Columbian, Shaffer.

RED—Marlboro, Herbert, Cuthbert.

THE STRAWBERRY

The strawberry is the most popular fruit cultivated in Ontario. This is doubtless due in part to the intrinsic value of the strawberry itself, which is one of the most delicious of fruits, but it is believed that the popularity of the strawberry comes largely from the fact that it can be grown by almost every one, as, unlike most fruits, very little land is required to produce sufficient for home consumption.

Strawberries can be grown in all parts of Ontario where the soil is suitable, hence large quantities are produced and consumed annually, and owing to the difference in the time of ripening between the southern and northern parts of the Province, the season is lengthened very much, and furthermore, the strawberries of one district do not come in such close competition with those from another as they would do if all ripened at the same time.

Strawberries will succeed on almost any rich well drained soil, but the largest crops are, it is believed, produced on a friable clay loam which is retentive of moisture. It is important, however, to avoid planting strawberries where water is likely to lie at any time, as surface water is very injurious to strawberries, and if water freezes over strawberries in winter they are almost sure to be killed.

Varieties Recommended

COMMERCIAL—Splendid (Perfect), Bederwood (P.), Warfield (Imperfect), not suited to light, sandy soil, Greenville (Imp.), Williams (P.), Saunders (P.), Sample (Imp.), Irene (Imp.), Buster (Imp.).

DOMESTIC—Van Deman (P.), Splendid (P.), Excelsior (P.), Dunlap (P.), Ruby (P.), Bubach (Imp.), Irene (Imp.), Belt (P.), Lovett (P.).

NOTE—In selecting varieties for planting, perfect-flowered varieties should be included to fertilize those having imperfect flowers.

NELSON MONTEITH,
Minister of Agriculture.

Canada Field Pea as a Cover Crop in the Rogue River Valley. See *Cover Crops under Apple.*

Canadian Fruit Marks Act. See *Laws.*

Candleberry

The candleberry is called also bayberry, candleberry myrtle, tallow tree and wax myrtle (*Myrica cerifera*). The nuts are called candle nuts and, when put into hot water, furnish a greenish colored substance waxy and oily, which, being refined, is made into candles. It grows in the wet soils of North America, near the seashore. The berries intended for making candles are gathered late in autumn. Another plant belonging to the same genus, grows in Scotland, a small shrub growing a little like the myrtle or willow, of a fragrant odor and a bitter taste, and yielding an essential oil by distillation. It was formerly used in the north of Europe instead of hops and in some places is still so used. In Sweden and Wales it is used in dyeing and produces a yellowish color.

Granville Lowther

Canning and Preserving Fruit in the Home

The common fruits, because of their low nutritive value, are not, as a rule, estimated at their real worth as food. Fruit has great dietetic value and should be used generously and wisely, both fresh and cooked. Fruits supply a variety of flavors, sugar, acids, and a necessary waste or bulky material for aiding in intestinal movement. They are generally rich in potash and soda salts and other minerals. Most fresh fruits are cooling and refreshing. The vegetable acids have a solvent power on the nutrients and are an aid to digestion when not taken in excess.

Fruit and fruit juices keep the blood in a healthy condition when the supply of fresh meat, fish, and vegetables is limited and salt or smoked meats constitute the chief elements of diet. Fresh fruit is generally more appetizing and refreshing than cooked. For this reason it is often eaten in too large quantities, and frequently when underripe or overripe; but when of good quality and eaten in moderate quantities it promotes healthy intestinal action and rarely hurts anyone.

If eaten immoderately, uncooked fruit is apt to induce intestinal disturbances. If eaten unripe, it often causes stomach and intestinal irritation; overripe, it has a tendency to ferment in the alimentary canal. Cooking changes the character and flavor of fruit, and while the product is not so cooling and refreshing as in the raw state, it can, as a rule, be eaten with less danger of causing stomach or intestinal trouble. If sugar be added to the cooked fruit, the nutritive value will be increased. A large quantity of sugar spoils the flavor of the fruit and is likely to make it less easily digested.

Nowhere is there greater need of a generous supply of fruit than on the farm, where the diet is apt to be restricted in variety because of the distance from markets. Every farmer should raise a generous supply of the kinds of fruit that can be grown in his locality. Wives and daughters on the farms should find pleasure in serving these fruits in the most healthful and tempting form. There are a large number of simple, dainty desserts that can be prepared with fruit and without much labor. Such desserts should leave the pie as an occasional luxury instead of allowing it to be considered a daily necessity.

In the season when each kind of fruit is plentiful and at its best a generous supply should be canned for the season when both fruit and fresh vegetables are scarce. A great deal of the fruit should be canned with little or no sugar, that it may be as nearly as possible in the condition of fresh fruit. This is the best condition for cooking purposes. A supply of glass jars does cost something, but that item of expense should be charged to future years as, with proper care, the breaking of a jar need be a rare occurrence. If there be an abundance of grapes and small, juicy fruits, plenty of juice should be canned or bottled for refreshing drinks throughout the year. Re-

member that the fruit and juice are not luxuries, but an addition to the dietary that will mean better health for the members of the family and greater economy in the cost of the table.

Fresh and Preserved Fruit for the Market

If the supply of fruit is greater than the family needs, it may be made a source of income by sending the fresh fruit to the market, if there is one near enough, or by preserving, canning, and making jelly for sale. To make such an enterprise a success the fruit and work must be first class. There is magic in the word "Home-made," when the product appeals to the eye and the palate; but many careless and incompetent people have found to their sorrow that this word has not magic enough to float inferior goods on the market. As a rule large canning and preserving establishments are clean and have the best appliances, and they employ chemists and skilled labor. The home product must be very good to compete with the attractive goods that are sent out from such establishments. Yet for first class home made products there is a market in all large cities. All first class grocers have customers who purchase such goods.

To secure a market, get the names of several first class grocers in some of the large towns. Write to them asking if they would be willing to try a sample of your goods. If the answer is favorable, send samples of the articles you wish to sell. In the box with the fruit inclose a list of the articles sent and the price. Write your name and address clearly. Mail a note and a duplicate list at the time you send the box. Fixing the price of the goods is important. Make it high enough to cover all expenses and give you a fair return for your labor. The expenses will be the fruit, sugar, fuel, jars, glasses, boxes, packing material, wear and tear of utensils, etc., transportation and commission. The commission will probably be 20 per cent of the selling price. It may be that a merchant will find your prices are too high or too low for his trade, or he may wish to purchase the goods outright. In any case it is essential that you estimate the full cost of the product and the value that you place on your labor. You will then be in a position to decide if the prices offered will compensate you for the labor and expense. Do not be tempted for the sake of a little money to deprive your family of the fruit necessary to health and pleasure.

Packing and Shipping

Each jar or jelly glass must be wrapped in several thicknesses of soft paper (newspapers will answer). Make pads of excelsior or hay by spreading a thick layer between the folds of newspapers. Line the bottom and sides of the box with these pads. Pack the fruit in the padded box. Fill all the spaces between the jars with the packing material. If the box is deep and a second layer of fruit is to go in, put thick pasteboard or thin boards over the first layer and set the wrapped jars on this. Fill all the spaces and cover the top with the packing material. Nail on the cover and mark clearly: GLASS. THIS SIDE UP.

The great secret in packing is to fill every particle of space so that nothing can move.

Principles of Canning and Preserving

In the preservation of foods by canning, preserving, etc., the most essential things in the processes are the sterilization of the food and all the utensils and the sealing of the sterilized food to exclude all germs.

Bacteria, Yeasts and Fermentation

Over 100 years ago Francois Appert was the first to make practical application of the method of preserving food by putting it in cans or bottles, which he hermetically sealed. He then put the full bottles or cans in water and boiled them for more or less time, depending upon the kinds of food.

In Appert's time and, indeed, until recent years, it was generally thought that the oxygen of the air caused the decomposition of food. Appert's theory was that the things essential to the preservation of food in this manner were the exclusion of air and the application of gentle heat,

as in the water bath, which caused a fusion of the principal constituents and ferments in such a manner that the power of the ferments was destroyed.

The investigations of scientists, particularly of Pasteur, have shown that it is not the oxygen of the air which causes fermentation and putrefaction, but bacteria and other microscopic organisms.

Appert's theory as to the cause of the spoiling of food was incorrect, but his method of preserving it by sealing and cooking was correct, and the world owes him a debt of gratitude.

In their investigations scientists have found that if food is perfectly sterilized and the opening of the jar or bottle plugged with sterilized cotton, food will not ferment, for the bacteria and yeasts to which such changes are due cannot pass through the cotton. This method cannot be conveniently followed with large jars.

Bacteria and yeasts exist in the air, in the soil, and on all vegetable and animal substances, and even in the living body, but although of such universal occurrence, the true knowledge of their nature and economic importance has only been gained during the last 40 years.

There are a great many kinds of these micro-organisms. Some do great harm, but it is thought that the greater part of them are beneficial rather than injurious.

Bacteria are one-celled and so small they can only be seen by aid of a microscope. The process of reproduction is simple and rapid. The bacterium becomes constricted, divides, and finally there are two cells instead of one. Under favorable conditions each cell divides, and so rapid is the work that it has been estimated that one bacterium may give rise, within 24 hours to 17,000,000 of similar organisms. The favorable conditions for growth are moisture, warmth and proper food. Yeasts, which are also one-celled organisms, grow less rapidly. A bud develops, breaks off, and forms a new yeast plant. Some yeasts and some kinds of bacteria produces spores. Spores, like the dried seeds of plants, may retain their vitality for a long time, even when exposed to conditions which kill the parent organism.

Yeasts and nearly all bacteria require oxygen, but there are species of the latter that seem to grow equally well without it, so that the exclusion of air, which, of course, contains oxygen, is not always a protection, if one of the anaerobic bacteria, as the kinds are called which do not require oxygen, is sealed in the can.

Spoiling of food is caused by the development of bacteria or yeasts.

Certain chemical changes are produced as shown by gases, odors and flavors.

Bacteria grow luxuriantly in foods containing a good deal of nitrogenous material, if warmth and moisture are present. Among foods rich in nitrogenous substances are all kinds of meat, fish, eggs, peas, beans, lentils, milk, etc. These foods are difficult to preserve on account of the omnipresent bacteria. This is seen in warm, muggy weather, when fresh meat, fish, soups, milk, etc., spoil quickly. Bacteria do not develop in substances containing a large percentage of sugar, but they grow rapidly in a suitable wet substance which contains a small percentage of sugar. Yeasts grow very readily in dilute solutions containing sugars in addition to some nitrogenous and mineral matters. Fruits are usually slightly acid and in general do not support bacterial growth, and so it comes about that canned fruits are more commonly fermented by yeasts than by bacteria.

Some vegetable foods have so much acid and so little nitrogenous substance that very few bacteria or yeasts attack them. Lemons, cranberries and rhubarb belong to this class.

Temperature is an important factor in the growth of bacteria and yeasts. There are many kinds of these organisms, and each kind grows best at a certain temperature, some at a very low one and others at one as high as 125 degrees Fahrenheit, or more. However, most kinds of bacteria are destroyed if exposed for 10 or 15 minutes to the temperature of boiling water (212 degrees Fahrenheit); but, if the bacteria are spore producers, cook-

ing must be continued for an hour or more to insure their complete destruction. Generally speaking, in order to kill the spores the temperature must be higher than that of boiling water, or the article to be preserved must be cooked for about two hours at a temperature of 212 degrees Fahrenheit, or a shorter time at a higher temperature under pressure. Yeasts and their spores are, however, more easily destroyed by heat than bacteria spores. Hence, fruits containing little nitrogenous material are more easily protected from fermentation than nitrogenous foods in which in general fermentation is caused by bacteria. Of course it is not possible to know what kinds of organisms are in the food one is about to can or bottle; but we do know that most fruits are not favorable to the growth of bacteria, and, as a rule, the yeasts which grow in fruits and fruit juices can be destroyed by cooking 10 or 15 minutes at a temperature of 212 degrees Fahrenheit. If no living organisms are left, and the sterilization of all appliances has been thorough, there is no reason why the fruit, if properly sealed, should not keep, with but slight change of texture or flavor, for a year or longer, although canned fruits undergo gradual change and deterioration even under the most favorable conditions.

When fruit is preserved with a large amount of sugar (a pound of sugar to a pound of fruit) it does not need to be hermetically sealed to protect it from bacteria and yeasts, because the thick, sugary syrup formed is not favorable to their growth. However, the self-sealing jars are much better than keeping such fruit in large receptacles, from which it is taken as needed, because molds grow freely on moist, sugary substances exposed to the air.

Molds and Molding

Every housekeeper is familiar with molds which, under favorable conditions of warmth and moisture, grow upon almost any kind of organic material. This is seen in damp, warm weather, when molds form in a short time on all sorts of starchy foods, such as boiled potatoes, bread, mush, etc., as well as fresh, canned, and preserved fruits.

Molds develop from spores which are always floating about in the air. When a spore falls upon a substance containing moisture and suitable food it sends out a fine thread, which branches and works its way over and into the attacked substance. In a short time spores are produced and the work of reproduction goes on.

In the first stages molds are white or light gray and hardly noticeable; but when spores develop the growth gradually becomes colored. In fact, the conditions of advanced growth might be likened to those of a flower garden. The threads—mycelium—might be likened to the roots of plants and the spores to the flower and seeds.

Mold spores are very light and are blown about by the wind. They are a little heavier than air, and drop on shelves, tables and floor, and are easily set in motion again by the movement of a brush, duster, etc. If one of these spores drops on a jar of preserves or a tumbler of jelly, it will germinate if there be warmth and moisture enough in the storeroom. Molds do not ordinarily cause fermentation of canned foods, although they are the common cause of the decay of raw fruits. They are not as injurious to canned goods as are bacteria and yeasts. They do not penetrate deeply into preserves or jellies, or into liquids or semi-liquids, but if given time they will, at ordinary room temperature, work all through suitable solid substances which contain moisture. Nearly every housekeeper has seen this in the molding of a loaf of bread or cake.

In the work of canning, preserving and jelly making it is important that the food shall be protected from the growth of molds as well as the growth of yeasts and bacteria.

To kill mold spores food must be exposed to a temperature of from 150 degrees Fahrenheit to 212 degrees Fahrenheit. After this it should be kept in a cool, dry place and covered carefully that no floating spore can find lodgment on its surface.

Sterilization

To sterilize a substance or thing is to destroy all life and sources of life in and about it. In following the brief outline of the structure and work of bacteria, yeasts and molds, it has been seen that damage to foods comes through the growth of these organisms on or in the food; also that if such organisms are exposed to a temperature of 212 degrees Fahrenheit, life will be destroyed, but that spores and a few resisting bacteria are not destroyed at a temperature of 212 degrees Fahrenheit unless exposed to it for two or more hours.

Bacteria and yeasts, which are intimately mixed with food, are not as easily destroyed as are those on smooth surfaces, such as the utensils and jars employed in the preparation of the food.

Since air and water, as well as the foods, contain bacteria and yeasts, and may contain mold spores, all utensils used in the process of preserving foods are liable to be contaminated with these organisms. For this reason all appliances, as well as the food, must be sterilized.

Stewpans, spoons, strainers, etc., may be put on the fire in cold or boiling water and boiled 10 or 15 minutes. Tumblers, bottles, glass jars, and covers should be put in cold water and heated gradually to the boiling point, and then boiled for 10 or 15 minutes. The jars must be taken one at a time from the boiling water at the moment they are to be filled with the boiling food. The work should be done in a well-swept and dusted room, and the clothing of the workers and the towels used should be clean.

In canning fruits it is well to remember that the product is more satisfactory if heated gradually to the boiling point and then cooked the given time.

Utensils Needed for Canning and Preserving

In preserving, canning, and jelly-making, iron or tin utensils should never be used. The fruit acids attack these metals and so give a bad color and metallic taste to the products. The preserving kettles should be porcelain lined, enameled, or of a metal that will not form troublesome chemical combinations with fruit juices. The kettles should be broad rather than deep, as the fruit should not be cooked in deep layers. Nearly all the necessary utensils may be found in some ware not subject to chemical action. A list of the most essential articles follows:

Two preserving kettles, one colander, one fine strainer, one skimmer, one ladle, one large-mouthed funnel, one wire frying basket, one wire sieve, four long-handled wooden spoons, one wooden masher, a few large pans, knives for paring fruit (plated if possible), flat-bottomed clothes boiler, wooden or willow rack to put in the bottom of the boiler, iron tripod or ring, squares of cheese cloth. In addition, it would be well to have a flannel straining bag, a frame on which to hang the bag, a syrup gauge and a glass cylinder, a fruit pricker, and plenty of clean towels. The regular kitchen pans will answer for holding and washing the fruit. Mixing bowls and stone crocks can be used for holding the fruit juice and pared fruit. When fruit is to be plunged into boiling water for a few minutes before paring, the ordinary stewpans may be employed for this purpose.

Scales are a desirable article in every kitchen, as weighing is much more accurate than the ordinary measuring. But, knowing that a large percentage of the housekeepers do not possess scales, it has seemed wise to give all the rules in measure rather than weight.

If canning is done by the oven process, a large sheet of asbestos, for the bottom of the oven, will prevent the cracking of jars.

The wooden rack, on which the bottles rest in the washboiler, is made in this manner: Have two strips of wood measuring one inch high, one inch wide, and two inches shorter than the length of the boiler. On these pieces of wood tack thin strips of wood that are one and one-half inches shorter than the width of the boiler. These cross-strips should be about one inch wide, and there should be an inch between two strips. This rack will support the jars and will admit the free circulation of boiling water about them.

Young willow branches, woven into a mat, also make a good bed for bottles and jars.

The wire basket is a saver of time and strength. The fruit to be peeled is put into the basket, which is lowered into a deep kettle partially filled with boiling water. After a few minutes the basket is lifted from the boiling water, plunged for a moment into cold water, and the fruit is ready to have the skin drawn off.

A strong wire sieve is a necessity when purees of fruit are to be made. These sieves are known as puree sieves. They are made of strong wire and in addition have supports of still stronger wire.

A fruit pricker is easily made and saves time. Cut a piece half an inch deep from a broad cork; press through this a dozen or more coarse darning needles; tack the cork on a piece of board. Strike the fruit on the bed of needles, and you have a dozen holes at once. When the work is finished, remove the cork from the board, wash and dry thoroughly. A little oil on the needles will prevent rusting. With needles of the size suggested there is little danger of the points breaking, but it is worth remembering that the use of pricking machines was abandoned in curing prunes on a commercial scale in California because the steel needles broke and remained in the fruit.

A wooden vegetable masher is indispensable when making jellies and purees.

A syrup gauge and glass cylinder are not essential to preserving, canning and jelly making, but they are valuable aids in getting the right proportion of sugar for fruit or jelly. The syrup gauge costs about 50 cents and the cylinder about 25 cents. A lipped cylinder that holds a little over a gill is the best size.

Small iron rings, such as sometimes come off the hub of cart wheels, may be used instead of a tripod for slightly raising the preserving kettels from the hot stove or range.

To make a flannel straining bag, take a square piece of flannel (27 by 27 inches is a good size), fold it to make a three-cornered bag, stitch one of the sides, cut the top square across, bind the opening with strong, broad tape, stitch on this binding four tapes with which to tie the bag to a frame.

To use this bag, tie it to a strong frame or to the backs of two kitchen chairs. If the chairs are used, place some heavy articles in them; or the bag may hang on a pole (a broom handle) which rests on the backs of the chairs. A high stool turned upside down makes a good support for the bag. Put a bowl on the floor under the bag, then pour in the fruit juice, which will pass through comparatively clear. Before it is used the bag should be washed and boiled in clear water.

Selection and Preparation of the Fruit

The selection of fruit is one of the first steps in obtaining successful results. The flavor of fruit is not developed until it is fully ripe, but the time at which the fruit is at its best for canning, jelly making, etc., is just before it is perfectly ripe. In all soft fruits the fermentative stage follows closely upon the perfectly ripe stage; therefore it is better to use underripe rather than overripe fruit. This is especially important in jelly making for another reason also: In overripe fruit the pectin begins to lose its jelly-making quality.

All fruits should, if possible, be freshly picked for preserving, canning, and jelly making. No imperfect fruit should be canned or preserved. Gnarly fruit may be used for jellies or marmalades by cutting out defective portions. Bruised spots should be cut out of peaches and pears. In selecting small-seeded fruits, like berries, for canning, those having a small proportion of seed to pulp should be chosen. In dry seasons berries have a larger proportion of seeds to pulp than in wet or normal seasons, and it is not wise to can or preserve such fruit unless the seeds are removed. The fruit should be rubbed through a sieve that is fine enough to keep back the seeds. The strained pulp can be preserved as a puree or marmalade. When fruit is brought into the house put it where it will keep cool and crisp until you are ready to use it.

The preparation of fruit for the various processes of preserving is the second important step. System will do much to lighten the work. Begin by having the kitchen swept and dusted thoroughly, that there need not be a large number of mold spores floating about. Dust with a damp cloth. Have plenty of hot water and pans in which jars and utensils may be sterilized. Have at hand all necessary utensils, towels, sugar, etc. Prepare only as much fruit as can be cooked while it still retains its color and crispness. Before beginning to pare fruit have some syrup ready, if that is to be used, or if sugar is to be added to the fruit have it weighed and measured.

Decide upon the amount of fruit you will cook at one time, then have two bowls—one for sugar and one for the fruit—that will hold just the quantity of each. As the fruit is pared or hulled, as the case may be, drop it into its measuring bowl. When the measure is full put the fruit and sugar in the preserving kettle. While this is cooking another measure may be prepared and put in the second preserving kettle. In this way the fruit is cooked quickly and put in the jars and sealed at once, leaving the pans ready to sterilize another set of jars.

If the fruit is to be preserved or canned with syrup, it may be put into the jars as fast as it is prepared. As soon as a jar is full, pour in enough syrup to cover it.

If several people are helping and large kettles are being used for the preserving, or where fruit (like quinces and hard pears) must be first boiled in clear water, the pared fruit should be dropped into a bowl of cold water made slightly acid with lemon juice (one tablespoonful of lemon juice to a quart of water). This will keep the fruit white.

All large, hard fruit must be washed before paring. Quinces should be rubbed with a coarse towel before they are washed. If berries must be washed, do the work before stemming or hulling them. The best way to wash berries is to put a small quantity into a colander and pour cold water over them; then turn them on a sieve to drain. All this work must be done quickly that the fruit may not absorb much water. Do not use the fingers for hulling strawberries. A simple huller can be bought for five cents.

If practicable pare fruit with a silver knife, so as not to stain or darken the product. The quickest and easiest way to peel peaches is to drop them into boiling water for a few minutes. Have a deep kettle a little more than half-full of boiling water; fill a wire basket with peaches; put a long-handled spoon under the handle of the basket and lower into the boiling water. Let the peaches drain a minute, then peel. Plums and tomatoes may be peeled in the same manner.

If the peaches are to be canned in syrup, put them at once into the sterilized jars. They may be canned whole or in halves. If in halves, remove nearly all the stones or pits. For the sake of the flavor, a few stones should be put in each jar.

When preparing cherries, plums, or crabapples for canning or preserving, the stem or a part of it may be left on the fruit.

When preparing to make jelly have ready the cheesecloth strainer, enameled colander, wooden spoons, vegetable masher, measures, tumblers, preserving kettles, and sugar.

If currant jelly is to be made, free the fruit from leaves and large stems. If the jelly is to be made from any of the other small fruits, the stems and hulls must be removed.

When the jelly is to be made from any of the larger fruits the important part of the preparation is to have the fruit washed clean, then to remove the stem and blossom end. Nearly all the large fruits are better for having the skin left on. Apples and pears need not be cored. There is so much gummy substance in the cores of quinces that it is best not to use this portion in making fine jelly.

Making Syrup for Use in Canning and Preserving

Such syrups as are used in canning and preserving are made with varying proportions of water and sugar. When the proportion of sugar is large and that of

PLATE V.

[illegible] Pears

See page [illegible]

the water small the syrup is said to be heavy. When the water predominates the syrup is light.

There are several methods of measusing the proportion of sugar in a syrup. The most scientific and accurate is with the syrup gauge. Careful measurement or weighing is, however, quite satisfactory for all ordinary work if the syrup need not be boiled a long time. In boiling the water evaporates and the syrup grows thicker and richer. The amount of evaporation depends upon the surface exposed and the pressure of the atmosphere. For example, if a large quantity of syrup is boiled in a deep kettle the evaporation will not be rapid. If the same quantity of syrup were boiled the same length of time in a high altitude, Colorado for example, and at the sea level, it would be found that the syrup boiled at the sea level would be thicker and less in volume than that boiled in Colorado. From this it will be seen that it is difficult to say what proportion of sugar a syrup will contain after it has been boiling 10 or more minutes. Of course by the use of the syrup gauge the proportion of sugar in a syrup may be ascertained at any stage of the boiling. After all, however, it is possible to measure sugar and water so that you can know the percentage of sugar when the syrup begins to boil. The following statement gives the percentage of sugar at the time when the syrup has been boiling one minute and also what kind of syrup is suitable for the various kinds of fruit:

One pint sugar and one gill of water gives syrup of 40 degrees density: Use for preserved strawberries and cherries.

One pint sugar and one-half pint water gives syrup of 32 degrees density.

One pint sugar and three gills water gives syrup of 28 degrees density: Use either this or the preceding for preserved peaches, plums, quinces, currants, etc.

One pint sugar and one pint water gives syrup of 24 degrees density: Use for canned acid fruits.

One pint sugar and one and one-half pints water gives syrup of 17 degrees density.

One pint sugar and two pints water gives syrup of 14 degrees density: Use either of these two light syrups for canned pears, peaches, sweet plums, and cherries, raspberries, blueberries, and blackberries.

The lightest syrups may be used for filling up the jars after they are taken from the oven or boiler. The process of making syrup is very simple, but there are a few points that must be observed if syrup and fruit are to be perfect. Put the sugar and water in the saucepan and stir on the stove until all the sugar is dissolved. Heat slowly to the boiling point and boil gently without stirring. The length of time that the syrup should boil will depend upon how rich it is to be. All syrups are better for boiling from 10 to 30 minutes. If rich syrups are boiled hard, jarred, or stirred, they are apt to crystallize. The syrup may be made a day or two in advance of canning time. The light syrups will not keep long unless sealed, the heavy syrups keep well if covered well.

Use of Syrup Gauge

The syrup gauge is a graduated glass tube, with a weighted bulb, that registers from no degrees to 50 degrees, and that is employed to determine the quantity of sugar contained in a syrup.

If this gauge is placed in pure water the bulb will rest on the bottom of the cylinder or other container. If sugar be dissolved in the water the gauge will begin to float. The more sugar there is dissolved in the water the higher the gauge will rise. In making tests it is essential that the syrup should be deep enough to reach the zero point of the gauge. If a glass cylinder holding about half a gill is filled to about two-thirds its height, and the gauge is then placed in the cylinder, the quantity of sugar in the syrup will be registered on the gauge.

Experiments have demonstrated that when sugar is dissolved and heated in fruit juice, if the syrup gauge registers 25 degrees, the proportion of sugar is exactly right for combining with the pectin bodies to make jelly. The syrup

gauge and the glass cylinder must both be heated gradually that the hot syrup may not break them. If the gauge registers more than 25 degrees, add more fruit juice. If, on the other hand, it registers less than 25 degrees, add more sugar. In making syrups for canning and preserving fruits, the exact amount of sugar in a syrup may be ascertained at any stage of boiling, and the syrup be made heavier by adding sugar, or lighter by adding water, as the case demands.

Canning Fruit

This method of preserving fruit for home use is, from all points, the most desirable. It is the easiest and commonly considered the most economical and the best, because the fruit is kept in a soft and juicy condition in which it is believed to be easily digested. The wise housekeeper will can her principal fruit supply, making only enough rich preserves to serve for variety and for special occasions.

The success of canning depends upon absolute sterilization. If the proper care is exercised there need be no failure, except in rare cases, when a spore has developed in the can. There are several methods of canning; and while the principle is the same in all methods, the conditions under which the housekeeper must do her work may, in her case, make one method more convenient than another. For this reason three will be given which are considered the best and easiest. These are: Cooking the fruit in the jars in an oven; cooking the fruit in the jars in boiling water; and stewing the fruit before it is put in the jars. The quantity of sugar may be increased if the fruit is liked sweet.

It is most important that the jars, covers, and rubber rings be in perfect condition. Examine each jar and cover to see that there is no defect in it. Use only fresh rubber rings, for if the rubber is not soft and elastic the sealing will not be perfect. Each year numbers of jars of fruit are lost because of the false economy in using an old ring that has lost its softness and elasticity. Having the jars, covers, and rings in perfect condition, the next thing is to wash and sterilize them.

Have two pans partially filled with cold water. Put some jars in one, laying them on their sides, and some covers in the other. Place the pans on the stove where the water will heat to the boiling point. The water should boil at least 10 or 15 minutes. Have on the stove a shallow milkpan in which there is about two inches of boiling water. Sterilize the cups, spoons and funnel, if you use one, by immersing in boiling water for a few minutes. When ready to put the prepared fruit in the jars slip a broad skimmer under a jar and lift it and drain free of water. Set the jar in the shallow milk pan and fill to overflowing with the boiling fruit. Slip a silver-plated knife or the handle of a spoon around the inside of the jar, that the fruit and juice may be packed solidly. Wipe the rim of the jar, dip the rubber ring in boiling water and put it smoothly on the jar, then put on the cover and fasten. Place the jar on a board and out of a draft of cold air. The work of filling and sealing must be done rapidly, and the fruit must be boiling hot when it is put into the jars. If screw covers are used, it will be necessary to tighten them after the glass has cooled and contracted. When the fruit is cold wipe the jars with a wet cloth. Paste on the labels, if any, and put the jars on shelves in a cool, dark closet.

In canning, any proportion of sugar may be used, or fruit may be canned without the addition of any sugar. However, that which is designed to be served as a sauce should have the sugar cooked with it. Fruit intended for cooking purposes need not have the sugar added to it.

Juicy fruits, such as berries and cherries, require little or no water. Strawberries are better not to have water added to them. The only exception to this is when they are cooked in a heavy syrup.

Raspberries

12 quarts of raspberries.
2 quarts of sugar.

Put two quarts of the fruit in the preserving kettle; heat slowly on the stove;

crush with a wooden vegetable masher; spread a square of cheesecloth over a bowl, and turn the crushed berries and juice into it. Press out the juice, which turn into the preserving kettle. Add the sugar and put on the stove; stir until the sugar is dissolved. When the syrup begins to boil, add the remaining 10 quarts of berries. Let them heat slowly. Boil 10 minutes, counting from the time they begin to bubble. Skim well while boiling. Put in cans and seal as directed.

Raspberries and Currants

10 quarts of raspberries.
3 quarts of currants.
2½ quarts of sugar.

Heat, crush, and press the juice from the currants and proceed as directed for raspberries.

Blackberries

The same as for raspberries.

Currants

12 quarts of currants.
4 quarts of sugar.

Treat the same as for raspberries.

Gooseberries

6 quarts of berries.
1½ quarts of sugar.
1 pint of water.

For green gooseberries dissolve the sugar in the water, then add the fruit and cook 15 minutes. Ripe gooseberries are to be treated the same as the green fruit, but use only half as much water. Green gooseberries may also be canned the same as rhubarb. (See *Rhubarb*.)

Blueberries

12 quarts of berries.
1 quart of sugar.
1 pint of water.

Put water, berries and sugar in the preserving kettle; heat slowly. Boil 15 minutes, counting from the time the contents of the kettle begin to bubble.

Cherries

6 quarts of cherries.
1½ quarts of sugar.
½ pint of water.

Measure the cherries after the stems have been removed. Stone them or not, as you please. If you stone them, be careful to save all the juice. Put the sugar and water in the preserving kettle and stir over the fire until the sugar is dissolved. Put in the cherries and heat slowly to the boiling point. Boil 10 minutes, skimming carefully.

Grapes

6 quarts of grapes.
1 quart of sugar.
1 gill of water.

Squeeze the pulp of the grapes out of the skins. Cook the pulp five minutes and then rub through a sieve that is fine enough to hold back the seeds. Put the water, skins and pulp into the preserving kettle and heat slowly to the boiling point. Skim the fruit and then add the sugar. Boil 15 minutes.

Sweet grapes may be canned with less sugar; very sour ones may have more.

Rhubarb

Cut the rhubarb when it is young and tender. Wash it thoroughly and then pare; cut into pieces about two inches long. Pack in sterilized jars. Fill the jars to overflowing with cold water and let them stand 10 minutes. Drain off the water and fill again to overflowing with fresh cold water. Seal with sterilized rings and covers. When required for use, treat the same as fresh rhubarb. Green gooseberries may be canned in the same manner. Rhubarb may be cooked and canned with sugar in the same manner as gooseberries.

Peaches

8 quarts of peaches.
1 quart of sugar.
3 quarts of water.

Put the sugar and water together and stir over the fire until the sugar is dissolved. When the syrup boils, skim it. Draw the kettle back where the syrup will keep hot but not boil.

Pare the peaches, cut in halves, and remove the stones, unless you prefer to can the fruit whole.

Put a layer of the prepared fruit into the preserving kettle and cover with some of the hot syrup. When the fruit begins to boil, skim carefully. Boil

gently for 10 minutes, then put in the jars and seal. If the fruit is not entirely ripe, it may require a little longer time to cook. It should be so tender that it may be pierced easily with a silver fork. It is best to put only one layer of fruit in the preserving kettle. While this is cooking the fruit for the next batch may be pared.

Pears

If the fruit is ripe it may be treated exactly the same as peaches. If, on the other hand, it is rather hard it must be cooked until so tender that a silver fork will pierce it readily.

Quinces

4 quarts of pared, cored and quartered quinces.
1½ quarts of sugar.
2 quarts of water.

Rub the fruit hard with a coarse, crash towel, then wash and drain. Pare, quarter, and core; drop the pieces into cold water (See *Selection and Preparation of the Fruit*—paragraph *re Quinces and Pears*). Put the fruit in the preserving kettle with cold water to cover it generously. Heat slowly and simmer gently until tender. The pieces will not all require the same time to cook. Take each piece up as soon as it is so tender that a silver fork will pierce it readily. Drain on a platter. Strain the water in which the fruit was cooked throu h cheesecloth. Put two quarts of the strained liquid and the sugar into the preserving kettle; stir over the fire until the sugar is dissolved. When it boils skim well and put in the cooked fruit. Boil gently for about 20 minutes.

Crab Apples

6 quarts of apples.
1½ quarts of sugar.
2 quarts of water.

Put the sugar and water into the preserving kettle. Stir over the fire until the sugar is dissolved. When syrup boils skim it.

Wash the fruit, rubbing the blossom end well. Put it in the boiling syrup, and cook gently until tender. It will take from 20 to 50 minutes, depending upon the kind of crab apples.

Plums

8 quarts of plums.
2 quarts of sugar.
1 pint of water.

Nearly all kinds of plums can be cooked with the skins on. If it is desired to remove the skin of any variety, plunge them in boiling water for a few minutes. When the skins are left on, prick them thoroughly to prevent bursting.

Put the sugar and water into the preserving kettle and stir over the fire until the sugar is dissolved. Wash and drain the plums. Put some of the fruit in the boiling syrup. Do not crowd it. Cook five minutes; fill and seal the jars. Put more fruit in the syrup. Continue in this manner until all the fruit is done. It may be that there will not be sufficient syrup toward the latter part of the work; for this reason it is well to have a little extra syrup on the back of the stove.

Stewed Tomatoes

Wash the tomatoes and plunge into boiling water for five minutes. Pare and slice, and then put into the preserving kettle; set the kettle on an iron ring. Heat the tomatoes slowly, stirring frequently from the bottom. Boil for 30 minutes, counting from the time the vegetable begins actually to boil. Put in sterilized jars and seal.

Whole Tomatoes

6 quarts of medium-sized tomatoes.
4 quarts of sliced tomatoes.

Put the pared and sliced tomatoes into a stewpan and cook as directed for stewed tomatoes. When they have been boiling 20 minutes take from the fire and rub through a strainer. Return to the fire.

While the sliced tomatoes are cooking, pare the whole tomatoes and put them in sterilized jars. Pour into the jars enough of the stewed and strained tomato to fill all the interstices. Put the uncovered jars in a moderate oven, placing them on a pad of asbestos or in shallow pans of hot water. Let the vegetable cook in the oven for half an hour. Take from the oven and fill to overflowing with

boiling hot, strained tomato, then seal. If there is any of the strained tomato left, can it for sauces.

Canned Fruit Cooked in the Oven

This method of canning fruit, in the opinion of the writer, is the one to be preferred. The work is easily and quickly done, and the fruit retains its shape, color, and flavor better than when cooked in the preserving kettle. Cover the bottom of the oven with a sheet of asbestos, the kind plumbers employ covering pipes. It is very cheap and may usually be found at plumbers' shops. If the asbestos is not available, put into the oven shallow pans in which there are about two inches of boiling water. Sterilize the jars and utensils. Make the syrup; prepare the fruit the same as for cooking in the preserving kettle. Fill the hot jars with it, and pour in enough syrup to fill the jar solidly. Run the blade of a silver-plated knife around the inside of the jar. Place the jars in the oven, either on the asbestos or in the pan of water. The oven should be moderately hot. Cook the fruit ten minutes; remove from the oven and fill the jar with boiling syrup. Wipe and seal. Place the jars on a board and out of a draft of air. If the screw covers are used tighten them after the glass has cooled.

Large fruits, such as peaches, pears, quinces, crab apples, etc., will require about a pint of syrup to each quart jar of fruit. The small fruit will require a little over half a pint of syrup.

The amount of sugar in each quart of syrup should be regulated to suit the fruit with which it is to be used.

Canned Fruit Cooked in a Water Bath

Prepare the fruit and syrup as for cooking in the oven.

Fill the sterilized jars and put the covers on loosely. Have a wooden rack in the bottom of a wash boiler. Put in enough warm water to come to about 4 inches above the rack. Place the filled jars in the boiler, but do not let them touch one another. Pack clean white cotton rags, or perhaps better, cotton rope, between and around the jars to prevent them from striking one another when the water begins to boil. Cover the boiler and let the fruit cook ten minutes from the time the water surrounding it begins to boil.

Draw the boiler back and take off the cover. When the steam passes off take out one jar at a time and place in a pan of boiling water beside the boiler, fill up with boiling syrup and seal. Put the jars on a board and do not let cold air blow upon them. If screw covers are used tighten them when the glass has cooled and contracted.

Preserving Fruit

In the case of most fruits, canning with a little sugar is to be preferred to preserving with a large quantity of sugar. There are, however, some fruits that are only good when preserved with a good deal of sugar. Of course, such preparations of fruit are only desirable for occasional use. The fruits best adapted for preserving are strawberries, sour cherries, sour plums, and quinces. Such rich preparations should be put up in small jars or tumblers.

Strawberries

Use equal weights of sugar and strawberries. Put the strawberries in the preserving kettle in layers, sprinkling sugar over each layer. The fruit and sugar should not be more than 4 inches deep. Place the kettle on the stove and heat the fruit and sugar slowly to the boiling point. When it begins to boil skim carefully. Boil ten minutes, counting from the time the fruit begins to bubble. Pour the cooked fruit into platters, having it about 2 or 3 inches deep. Place the platters in a sunny window, in an unused room, for three or four days. In that time the fruit will grow plump and firm, and the syrup will thicken almost to a jelly. Put this preserve, cold, into jars or tumblers.

White Currants

Select large, firm fruit, remove the stems, and proceed as for strawberries.

Cherries

The sour cherries, such as Early Richmond and Montmorency, are best for

this preserve. Remove the stems and stones from the cherries and proceed as for strawberry preserve.

Cherries Preserved with Currant Juice

12 quarts of cherries
3 quarts of currants
2 quarts of sugar

Put the currants in the preserving kettle and on the fire. When they boil up crush them and strain through cheesecloth, pressing out all the juice. Stem and stone the cherries, being careful to save all the juice. Put the cherries, fruit juice, and sugar in the preserving kettle. Heat to the boiling point and skim carefully. Boil for twenty minutes. Put in sterilized jars or tumblers. This gives an acid preserve. The sugar may be doubled if richer preserves are desired.

Plum Preserve

4 quarts of green gages.
2 quarts of sugar.
1 pint of water.

Prick the fruit and put it in a preserving kettle. Cover generously with cold water. Heat to the boiling point and boil gently for five minutes. Drain well.

Put the sugar and water in a preserving kettle and stir over the fire until the sugar is dissolved. Boil five minutes, skimming well. Put the drained green gages in this syrup and cook gently for twenty minutes. Put in sterilized jars.

Other plums may be preserved in the same manner. The skins should be removed from white plums.

Quinces

4 quarts of pared, quartered, and cored quinces.
2 quarts of sugar.
1 quart of water.

Boil the fruit in clear water until it is tender, then skim out and drain. Put the 2 quarts of sugar and 1 quart of water in the preserving kettle; stir until the sugar is dissolved. Let it heat slowly to the boiling point. Skim well and boil for twenty minutes. Pour one-half of the syrup into a second kettle. Put one-half of the cooked and drained fruit into each kettle. Simmer gently for half an hour, then put in sterilized jars. The water in which the fruit was boiled can be used with parings, cores, and gnarly fruit to make jelly.

Fruit Purees

Purees of fruit are in the nature of marmalades, but they are not cooked so long, and so retain more of the natural flavor of the fruit. This is a particularly nice way to preserve the small, seedy fruits, which are to be used in puddings, cake, and frozen desserts.

Free the fruit from leaves, stems, and decayed portions. Peaches and plums should have the skins and stones removed. Rub the fruit through a puree sieve. To each quart of the strained fruit add a pint of sugar. Pack in sterilized jars. Put the covers loosely on the jars. Place the jars on the rack in the boiler. Pour in enough cold water to come half way up the sides of the jars. Heat gradually to the boiling point and boil thirty minutes, counting from the time when the water begins to bubble. Have some boiling syrup ready. As each jar is taken from the boiler put it in a pan of hot water and fill up with the hot syrup. Seal at once.

Marmalades

Marmalades require great care while cooking because no moisture is added to the fruit and sugar. If the marmalade is made from berries the fruit should be rubbed through a sieve to remove the seeds. If large fruit is used have it washed, pared, cored, and quartered.

Measure the fruit and sugar, allowing one pint of sugar to each quart of fruit.

Rinse the preserving kettle with cold water that there may be a slight coat of moisture on the sides and bottom. Put alternate layers of fruit and sugar in the kettle, having the first layer fruit. Heat slowly, stirring frequently. While stirring, break up the fruit as much as possible. Cook about two hours, then put in small sterilized jars.

Fruit Preserved in Grape Juice

Any kind of fruit can be preserved by this method, but it is particularly good

for apples, pears, and sweet plums. No sugar need be used in this process.

Boil 6 quarts of grape juice in an open preserving kettle, until it is reduced to 4 quarts. Have the fruit washed and pared, and, if apples or pears, quartered and cored. Put the prepared fruit in a preserving kettle and cover generously with the boiled grape juice. Boil gently until the fruit is clear and tender, then put in sterilized jars.

Boiled Cider

When the apple crop is abundant and a large quantity of cider is made, the housekeeper will find it to her advantage to put up a generous supply of boiled cider. Such cider greatly improves mince-meat, and can be used at any time of the year to make cider apple sauce. It is also a good selling article.

The cider for boiling must be perfectly fresh and sweet. Put it in a large, open preserving kettle and boil until it is reduced one-half. Skim frequently while boiling. Do not have the kettle more than two-thirds full.

Put in bottles or stone jugs.

Cider Apple Sauce

5 quarts of boiled cider.

8 quarts of pared, quartered, and cored sweet apples.

Put the fruit in a large preserving kettle and cover with the boiled cider. Cook slowly until the apples are clear and tender. To prevent burning, place the kettle on an iron tripod or ring. It will require from two to three hours to cook the apples. If you find it necessary to stir the sauce be careful to break the apples as little as possible. When the sauce is cooked, put in sterilized jars.

In the late spring, when cooking apples have lost much of their flavor and acidity, an appetizing sauce may be made by stewing them with diluted boiled cider, using 1 cupful of cider to 3 of water.

Cider Pear Sauce

Cooking pears may be preserved in boiled cider the same as sweet apples. If one prefers the sauce less sour, 1 pint of sugar may be added to each quart of boiled cider.

Methods of Making Jelly

In no department of preserving does the housekeeper feel less sure of the result than in jelly making. The rule that works perfectly one time fails another time. Why this is so the average housekeeper does not know; so there is nearly always an element of uncertainty as to the result of the work. These two questions are being constantly asked: "Why does not my jelly harden?" "What causes my jelly to candy?"

It is an easy matter to say that there is something in the condition of the fruit, or that the fruit juice and sugar were cooked too short or too long a time. These explanations are often true; but they do not help the inquirer, since at other times just that proportion of sugar and time of cooking have given perfect jelly. In the following pages an attempt is made to give a clear explanation of the principles underlying the process of jelly making. It is believed that the women who study this carefully will find the key to unvarying success in this branch of preserving.

Pectin, Pectose, Pectase

In all fruits, when ripe or nearly so, there is found pectin, a carbohydrate somewhat similar in its properties to starch. It is because of this substance in the fruit juice that we are able to make jelly. When equal quantities of sugar and fruit juice are combined and the mixture is heated to the boiling point for a short time, the pectin in the fruit gelatinizes the mass.

It is important that the jelly maker should understand when this gelatinizing agent is at its best. Pectose and pectase always exist in the unripe fruit. As the fruit ripens the pectase acts upon the pectose, which is insoluble in water, converting it into pectin, which is soluble. Pectin is at its best when the fruit is just ripe or a little before. If the juice ferments, or the cooking of the jelly is continued too long, the pectin undergoes a change and loses its power of gelatinizing. It is, therefore, of the greatest importance that the fruit should be fresh, just ripe or a little underripe, and that

the boiling of the sugar and juice should not be continued too long.

Fruits vary as to the quantities of sugar, acid, pectin, and gums in their composition. Some of the sour fruits contain more sugar than do some of the milder-flavored fruits. Currants, for example, often contain four or five times as much sugar as the peach. The peach does not contain so much free acid and it does contain a great deal of pectin bodies, which mask the acid; hence, the comparative sweetness of the ripe fruit.

Selection and Handling of Fruit for Jelly Making

An acid fruit is the most suitable for jelly making, though in some of the acid fruits, the strawberry, for example, the quantity of the jelly-making pectin is so small that it is difficult to make jelly with this fruit. If, however, some currant juice be added to the strawberry juice, a pleasant jelly will be the result; yet, of course, the flavor of the strawberry will be modified. Here is a list of the most desirable fruits for jelly making. The very best are given first: Currant, crab apple, apple, quince, grape, blackberry, raspberry, peach.

Apples make a very mild jelly, and it may be flavored with fruits, flowers, or spices. If the apples are acid it is not advisable to use any flavor. Juicy fruits, such as currants, raspberries, etc., should not be gathered after a rain, for they will have absorbed so much water as to make it difficult, without excessive boiling, to get the juice to jelly. If berries are sandy or dusty it will be necessary to wash them, but the work should be done very quickly so that the fruit may not absorb much water.

Large fruits, such as apples, peaches, and pears, must be boiled in water until soft. The strained liquid will contain the flavoring matter and pectin.

It requires more work and skill to make jellies from the fruits to which water must be added than from the juicy fruits. If the juicy fruits are gathered at the proper time one may be nearly sure that they contain the right proportion of water. If gathered after a rain the fruit must be boiled a little longer than the superfluous water may pass off in steam. In the case of the large fruits a fair estimate is 3 quarts of strained juice from 8 quarts of fruit and about 4 quarts of water. If the quantity of juice is greater than this it should be boiled down to 3 quarts. Apples will always require 4 quarts of water to 8 quarts of fruit, but juicy peaches and plums require only 3 or 3½ quarts.

The jelly will be clearer and finer if the fruit is simmered gently and not stirred during cooking.

It is always best to strain the juice first through cheesecloth and without pressure. If the cloth is double the juice will be quite clear. When a very clear jelly is desired the strained juice should pass through a flannel or felt bag. The juice may be pressed from the fruit left in the strainer and used in marmalade or for second-quality jelly.

To make jelly that will not crystallize (candy) the right proportion of sugar must be added to the fruit juice. If the fruit contains a high percentage of sugar, the quantity of added sugar should be a little less than the quantity of fruit juice. That is to say, in a season when there has been a great deal of heat and sunshine there will be more sugar in the fruit than in a cold, wet season; consequently, 1 pint of currant juice will require but three-quarters of a pint of sugar. But in a cold, wet season the pint of sugar for the pint of juice must be measured generously.

Another cause of the jelly crystallizing is hard boiling. When the syrup boils so rapidly that particles of it are thrown on the upper part of the sides of the preserving kettle they often form crystals. If these crystals are stirred into the syrup they are apt to cause the mass to crystallize in time.

The use of the syrup gauge and care not to boil the syrup too violently would do away with all uncertainty in jelly making. The syrup gauge should register 25 degrees, no matter what kind of fruit is used. Jellies should be covered

closely and kept in a cool, dry, dark place.

Currant Jelly

The simplest method of making currant jelly is perhaps the following: Free the currants from leaves and large stems. Put them in the preserving kettle; crush a few with a wooden vegetable masher or spoon; heat slowly, stirring frequently.

When the currants are hot, crush them with the vegetable masher. Put a hair sieve or strainer over a large bowl; over this spread a double square of cheesecloth. Turn the crushed fruit and juice into the cheesecloth, and let it drain as long as it drips, but do not use pressure. To hasten the process take the corners of the straining cloth firmly in the hands and lift from the sieve; move the contents by raising one side of the cloth and then the other. After this put the cloth over another bowl. Twist the ends together and press out as much juice as possible. This juice may be used to make a second quality of jelly.

The clear juice may be made into jelly at once, or it may be strained through a flannel bag. In any case, the method of making the jelly is the same.

Measure the juice, and put it in a clean preserving kettle. For every pint of juice add a pint of granulated sugar.

Stir until the sugar is dissolved, then place over the fire; watch closely, and when it boils up draw it back and skim; put over the fire again, and boil and skim once more; boil and skim a third time; then pour into hot glasses taken from the pan of water on the stove and set on a board. Place the board near a sunny window in a room where there is no dust. It is a great protection and advantage to have sheets of glass to lay on top of the tumblers. As soon as the jelly is set cover by one of the three methods given under "Covering Jellies."

To make very transparent currant jelly, heat, crush, and strain the currants as directed in the simplest process. Put the strained juice in the flannel bag and let it drain through. Measure the juice and sugar, pint for pint, and finish as directed above.

To make currant jelly by the cold process follow the first rule for jelly as far as dissolving the sugar in the strained juice. Fill warm, sterilized glasses with this. Place the glasses on a board and put the board by a sunny window. Cover with sheets of glass and keep by the window until the jelly is set. The jelly will be more transparent if the juice is strained through the flannel bag. Jelly made by the cold process is more delicate than that made by boiling, but it does not keep quite so well.

Raspberry and Currant Jelly

Make the same as currant jelly, using half currants and half raspberries.

Raspberry Jelly

Make the same as currant jelly.

Blackberry Jelly

Make the same as currant jelly.

Strawberry Jelly

To 10 quarts of strawberries add 2 quarts of currants and proceed as for currant jelly, but boil fifteen minutes.

Ripe Grape Jelly

An acid grape is best for this jelly. The sweet, ripe grapes contain too much sugar. Half-ripe fruit, or equal portions of nearly ripe and green grapes, will also be found satisfactory. Wild grapes make delicious jelly. Make the same as currant jelly.

Green Grape Jelly

Make the same as apple jelly.

Plum Jelly

Use an underripe acid plum. Wash the fruit and remove the stems. Put into the preserving kettle with 1 quart of water for each peck of fruit. Cook gently until the plums are boiled to pieces. Strain the juice and proceed the same as for currant jelly.

Apple Jelly

Wash, stem, and wipe the apples, being careful to clean the blossom end thoroughly. Cut into quarters and put into the preserving kettle. Barely cover with

cold water (about 4 quarts to 8 of apples) and cook gently until the apples are soft and clear. Strain the juice and proceed as for currant jelly. There should be but 3 quarts of juice from 8 quarts of apples and 4 of water.

Apples vary in the percentage of sugar and acid they contain. A fine-flavored acid apple should be employed when possible. Apple jelly may be made at any time of the year, but winter apples are best and should be used when in their prime, i. e, from the fall to December or January. When it is found necessary to make apple jelly in the spring, add the juice of one lemon to every pint of apple juice.

Cider Apple Jelly

Make the same as plain apple jelly, but covering the apples with cider instead of water. The cider must be fresh from the press.

Crab Apple Jelly

Make the same as plain apple jelly.

Quince Jelly

Rub the quinces with a coarse crash towel; cut out the blossom end. Wash the fruit and pare it and cut in quarters. Cut out the cores, putting them in a dish by themselves. Have a large bowl half full of water; drop the perfect pieces of fruit into this bowl. Put the parings and imperfect parts, cut very fine, into the preserving kettle. Add a quart of water to every 2 quarts of fruit and parings. Put on the fire and cook gently for two hours. Strain and finish the same as apple jelly. The perfect fruit may be preserved or canned.

To make quince jelly of a second quality, when the parings and fruit are put on to cook put the cores into another kettle and cover them generously with water and cook two hours. After all the juice has been drained from the parings and fruit, put what remains into the preserving kettle with the cores. Mix well and turn into the straining cloth. Press all the juice possible from this mixture. Put the juice in the preserving kettle with a pint of sugar to a pint of juice; boil ten minutes.

Wild Fruits for Jellies

Wild raspberries, blackberries, barberries, grapes, and beach plums all make delicious jellies. The frequent failures in making barberry jelly come from the fruit not being fresh or from being overripe.

Preparation of the Glasses for Jelly

Sterilize the glasses; take from the boiling water and set them in a shallow baking pan in which there is about 2 inches of boiling water.

Covering Jellies

Jellies are so rich in sugar that they are protected from bacteria and yeasts, but they must be covered carefully to protect them from mold spores and evaporation. The following methods of covering jellies are good:

Have disks of thick white paper the size of the top of the glass. When the jelly is set, brush the top over with brandy or alcohol. Dip the disk of paper in the spirits and put it on the jelly. If the glasses have covers, put them on. If there are no covers, cut disks of paper about half an inch in diameter larger than the top of the glass. Beat together the white of one egg and a tablespoonful of cold water. Wet the paper covers with this mixture and put over the glass, pressing down the sides well to make them stick to the glass; or the covers may be dipped in olive oil and tied on the glasses, but they must be cut a little larger than when the white of egg is used.

A thick coating of paraffin makes a good cover, but not quite so safe as the paper dipped in brandy or alcohol, because the spirits destroy any mold or spores that may happen to rest on the jelly. If such spores are covered with the paraffin they may develop under it. However, the paper wet with spirits could be put on first and the paraffin poured over it.

If paraffin is used, break it into pieces and put in a cup. Set the cup in a pan of warm water on the back of the stove. In a few moments it will be melted enough to cover the jelly. Have the coating

about a fourth of an inch thick. In cooling the paraffin contracts, and if the layer is very thin it will crack and leave a portion of the jelly exposed.

Canned or Bottled Fruit Juices

Fruit juice is most desirable for drinking or for culinary purposes. Grape juice is particularly good as a drink. It may be canned with or without sugar, but, except where the grapes have a large percentage of sugar, as is the case in California, some sugar should be added to the juice in canning. Currant juice may be sterilized and canned without sugar. This juice may be made into jelly at any season of the year.

Fruit juices that are designed for use in frozen creams and water ices should be canned with a generous amount of sugar.

For grape juice good bottles are to be preferred to fruit cans. If you can get the self-sealing bottles, such as pop or beer comes in, the work of putting up grape juice will be light. If bottles are employed, be very careful to sterilize both bottles and corks.

Grape Juice

Wash the grapes and pick from the stems. Put the fruit in the preserving kettle and crush slightly. Heat slowly and boil gently for half an hour. Crush the fruit with a wooden spoon.

Put a sieve or colander over a large bowl and spread a square of cheesecloth over the sieve. Turn the fruit and juice into the cheesecloth; drain well, then draw the edges of the cheesecloth together and twist hard to press out all the juice possible.

Put the strained juice in a clean preserving kettle and on the fire. When it boils up, draw back and skim. Let it boil up again and skim; then add the sugar and stir until dissolved. Boil five minutes, skimming carefully. Fill hot sterilized jars or bottles. Put the jars or bottles in a moderate oven for ten minutes, in pans of boiling water. Have some boiling juice and pour a little of it into the jars as they are taken from the oven; then seal. Place on boards and set aside out of a cold draft. A good proportion of sugar and juice is 1 gill of sugar to a quart of juice.

Raspberry, Blackberry, Strawberry and Currant Juices

With all these fruits except currants, proceed the same as for grape juice, but adding half a pint of sugar to each quart of juice. Currants will require 1 pint of sugar to a quart of juice.

Cherry, Plum and Peach Juices

To preserve the juice of cherries, plums, peaches, and similar fruits, proceed as for jelly, but adding to each quart of juice half a pint of sugar instead of a quart as for jelly. If it is not desired to have the fruit juice transparent, the pulp of the fruit may be pressed to extract all the liquid.

Fruit Syrups

The only difference between syrups and juice is that in the syrup there must be at least half as much sugar as fruit juice.

These syrups are used for flavoring ice creams and water ices. They also make a delicious drink, when two or three spoonfuls are added to a glass of ice water.

Raspberry Vinegar

Put 4 quarts of raspberries in a bowl and pour over them 2 quarts of vinegar. Cover and set in a cool place for two days. On the second day strain the vinegar through cheesecloth. Put 4 quarts of fresh raspberries in the bowl and pour over them the vinegar strained from the first raspberries. Put in a cool place for two days, then strain. Put the strained juice in a preserving kettle with 3 quarts of sugar. Heat slowly, and when the vinegar boils skim carefully. Boil twenty minutes, then put in sterilized bottles.

About 2 tablespoonfuls of vinegar to a glass of water makes a refreshing drink.

Similar vinegars may be made from blackberries and strawberries.

MARIA PARLOA,

U. S. Department of Agriculture, Farmers Bulletin No. 203

Canning Vegetables in the Home

One of the many problems that confront the American housewife is the supply of vegetables for her table during the winter months. "What can I have for dinner today?" is a question often heard. Since the advent of the modern greenhouse and the forcing of vegetables under glass, fresh vegetables can usually be found at any time in the markets of the large cities. But the cost of forcing vegetables or growing them out of season is and will continue to be very great. This makes the price so high as almost to prohibit their use by people of moderate means, except as a luxury. A healthful diet, however, must include vegetables, and therefore the housewife turns to canned goods as the only alternative. These are sometimes poor substitutes for the fresh article, especially the cheaper commercial grades, which necessarily lack the delicate flavor of the fresh vegetable. There is practically no danger, however, from contamination with tin or other metals providing the containers are made of proper materials and handled carefully. In some cases the proper care is not taken in packing vegetables for market. The decayed and refuse portions are not so carefully removed as they should be and the requisite degree of cleanliness is not observed in their packing. Happily, however, such carelessness is not general.

Every housewife may run a miniature canning factory in her own kitchen, and on the farm this is especially economical and desirable, the economy being less pronounced in the case of city dwellers, who must buy their fruits and vegetables. Enough vegetables annually go to waste from the average farm garden to supply the table during the entire winter. But usually the farmer's wife cans her tomatoes, preserves her fruits, and leaves her most wholesome and nutritious vegetables to decay in the field, under the impression that it is impossible to keep them. This is a great mistake. It is just as easy to keep corn or string beans as it is to keep tomatoes, if you know how.

The same general methods for sterilization and canning operations should be followed in the canning of vegetables as in the canning of fruits.

So-Called "Preserving Powders"

There are a great many brands of so-called "preserving powders" on the market. These are sold not only under advertised trade names, but by druggists and peddlers everywhere. In the directions for use the housewife is told to fill the jar with the fruit or vegetable to be canned, to cover with water, and to add a teaspoonful of the powder. It is true that these powders may prevent the decay of the fruit or vegetable, but they also encourage uncleanly, careless work, and in the hands of inexperienced persons may be dangerous. While with small doses the influence may not be apparent in an adult in normal health, with a child or an invalid the effect may be of a serious nature. The proper way to sterilize is by means of heat, and as this can be done very easily and cheaply the use of chemical preservatives in canning is not to be recommended.

Kinds of Jars

The first requisite for successful canning is a good jar. Glass is the most satisfactory. Tin is more or less soluble in the juices of fruits and vegetables. Even the most improved styles of tin cans which are lacquered on the inside to prevent the juice from coming in contact with the tin are open to this objection. While the small amount of tin may not be injurious, it gives an undesirable color to many canned articles. Tin cans can not readily be used a second time, while glass with proper care will last indefinitely.

There are a great many kinds of glass jars on the market, many of them possessing certain distinct points of advantage. The ordinary screw-top jar is the one in most common use. Although cheap in price, these jars are the most expensive in the long run. The tops last only a few years and, being cheaply made, the breakage is usually greater than that of

a better grade of jar. The tops also furnish an excellent hiding place for germs, which makes sterilization very difficult. An improved type of screw-top jar is now in use. These are fitted with a glass top held in place by a metal cover which screws down over the neck of the jar. If the canning or sterilization is conducted properly, practically all of the air will be driven out of the jar by the steam. Upon cooling, this is condensed, a vacuum is formed on the inside which clamps down the glass top against the rubber ring and seals the jar automatically. The metal cover can then be removed, as the pressure of the outside air will hold the glass top securely in place.

Another type of jar in common use requires no rubber rings, but is fitted with a metal top, lacquered on both sides and having a groove around the lower edge. This groove contains a composition of the consistency of rubber which is melted during canning by the heat of the jar and forms a seal that takes the place of the rubber ring. These metal tops must be renewed each year, as it is necessary to puncture them in order to open the jar.

The most satisfactory jar that the writer has had any experience with has a rubber ring and glass top which is held in place by a simple wire spring. There are several brands of these jars on the market, so no difficulty should be experienced in obtaining them. Vegetables often spoil after being sterilized because of defective rubbers. It is poor economy to buy cheap rubbers or to use them a second time. As a general rule black rubbers are more durable than white ones.

Buy a good grade of jar. The best quality usually retails at from a $1 to a $1.25 a dozen. The initial expense may be, therefore, somewhat high, but with proper care they should last many years. The annual breakage should be less than 3 per cent on the average. In selecting a jar always give preference to those having wide mouths. In canning whole fruit or vegetables and in cleaning the jars the wide mouth will be found to be decidedly preferable.

Containers for Sterilizing

The writer uses a tin clothes boiler with a false bottom made of wire netting cut to fit it. The netting is made of medium-sized galvanized wire (No. 16) with one-half inch mesh. A false bottom is absolutely necessary, as the jars will break if set flat upon the bottom of the boiler. Narrow strips of wood, straw, or almost anything of this nature may be used for the purpose, but the wire gauze is clean and convenient.

There are several varieties of patent steamers or steam cookers in common use. These have either one or two doors and hold a dozen or more quart jars. They are ideal for canning, but they are somewhat expensive and can be easily dispensed with. A common ham boiler or clothes boiler with a tight-fitting cover will answer every purpose.

Selection and Preparation of Vegetables

The first step in successful canning is the selection and preparation of the vegetables. Never attempt to can any vegetable that has matured and commenced to harden or one that has begun to decay. As a general rule, young vegetables are superior in flavor and texture to the more mature ones. This is especially true of string beans, okra, and asparagus. Vegetables are better if gathered in the early morning while the dew is still on them. If it is impossible to can them immediately, do not allow them to wither, but put them in cold water or in a cold, damp place and keep them crisp until you are ready for them. Do your canning in a well-swept and well-dusted room. This will tend to reduce the number of spores floating about and lessen the chances of inoculation.

In the following pages are given instructions for canning some of the more common vegetables, but the housewife can add to these at will. The principle of sterilization is the same for all meats, fruits, vegetables.

Corn

Contrary to the general opinion, corn is one of the easiest vegetables to can. The United States Department of Agriculture has shown that the amount of

sugar in the sweet varieties diminishes very rapidly after the ear is pulled from the stalk; therefore in order to retain the original sweetness and flavor it is necessary to can corn very soon after it is pulled—within an hour if possible. Select the ears with full grains before they have begun to harden, as this is the period of greatest sugar content. Husk them and brush the silks off with a stiff brush. Shear off the grains with a sharp knife and pack the jar full. Add salt to taste, usually about a teaspoonful to the quart is sufficient, and fill up the jar to the top with cold water. Put the rubber ring around the neck of the jar and place the top on loosely. Be careful not to press down the spring at the side of the jar.

Place the false bottom in the boiler and put in as many jars as the boiler will conveniently hold. Don't try to crowd them in. Leave space between them. Pour in about 3 inches of cold water, or just enough to form steam and to prevent the boiler from going dry during the boiling. It is not necessary to have the water up to the neck of the jars, as the steam will do the cooking. Put the cover on the boiler and set it on the stove. Bring the water to a boil and keep it boiling for one hour. At the end of that time remove the cover of the boiler and allow the steam to escape. Press down the spring at the side of the jar. This clamps on the top and will prevent any outside air from entering. The jars can now be removed and cooled or allowed to stand in the boiler until the next day.

On the second day raise the spring at the side of the jar. This will relieve any pressure from steam that might accumulate inside the jar during the second cooking. Place the jars again in the boiler and boil for one hour. Clamp on the top as on the preceding day and allow them to cool. Repeat this operation on the third day. In removing the jars from the boiler be careful not to expose them to a draft of cold air while they are hot, as a sudden change in temperature is likely to crack them.

After the sterilization is complete the jars may be set aside for a day or two and then tested. This is done by releasing the spring at the side and picking up the jar by the top. If there has been the least bit of decomposition, or if sterilization has not been complete, the top will come off. This is because the pressure on the top has been relieved by the gas formed by the bacteria. In this case it is always best to empty out the corn and fill up the jar with a fresh supply. If canning fruits or some expensive vegetable, however, examine the contents of the jar and, if the decomposition has not gone far enough to injure the flavor, place it once more in the boiler and sterilize over again. If the top does not come off, you may feel sure that the vegetable is keeping.

String Beans

Select young and tender beans, string them, and break them into short lengths. Pack firmly in the jar, cover with cold water, and add a teaspoon of salt to each quart. Put on the rubber and top and boil for one hour on each of three successive days, as directed under "Corn." A small pod of red pepper placed in the bottom of the jar will give a delightful flavor to this vegetable.

Egg Plant

Pare the egg plant, cut in thin slices, and drop in boiling water for fifteen or twenty minutes. Drain off the water and pack the slices in the jar. Cover with water and sterilize as directed under "Corn." The slices of egg plant are pliable and may be taken from the jar without being broken and either fried in bread crumbs or made into pudding and baked.

Beets

Although beets will keep in the cellar over winter, it is very desirable to can them while they are young and tender, as the mature beet is apt to be stringy and lacking in flavor. Wash the young beets, cut off the tops, and put them in boiling water for about an hour and a half, or until they are thoroughly cooked. Take off the skins, cut in thin slices, and pack into the jars. Cover with water and sterilize in the manner previously described. If a mild pickle is desired, make a mixture of equal parts

of water and good vinegar, sweeten to taste, and cover the beets with this mixture instead of water.

Okra or Gumbo

This is a vegetable worthy of more extended culture. Although extensively grown in the South, it is comparatively unknown in the North. It is easily kept and makes a delicious vegetable for the winter. Wash the young and tender pods, cut them in short lengths, pack in the jars, cover with water and sterilize. Okra is used for soups or stews.

Summer Squash

Cut the vegetables into small blocks, pack in the jars, and cover with water. Add a teaspoon of salt to each quart and sterilize. It is sometimes preferable with this vegetable, however, to pare off the skin, boil or steam until thoroughly done, mash them, and then pack in the jars and sterilize. If canned in the latter way, it is advisable to steam them for an hour and a half, instead of for an hour, on each of three days, as the heat penetrates the jar very slowly. It is absolutely necessary that the interior of the jar should reach the temperature of boiling water. A jar will usually hold about twice as much of the cooked vegetable as it will of the uncooked.

English Peas

When prepared and canned in the proper way, peas are easily kept and never lose the delicate flavor that they possess when fresh. Shell the young peas, pack in jars, and sterilize as directed under "Corn."

Asparagus

Can the young tips only, in the same way as you would corn.

Cauliflower

This vegetable usually keeps very well, but if the supply for the winter should begin to spoil it may be necessary to can it during the summer. Prepare it as you would for the table, pack it into jars, and sterilize.

Carrots and Parsnips

These, if gathered during the early summer and canned, make most excellent vegetables for the winter. The young plants at that season are not stringy and have not yet developed the strong taste that is so objectionable to some people. Prepare as you would for the table, and sterilize.

Tomatoes

Every housewife knows how to can tomatoes. They are very easily kept, even in the common screw-top jar. If one already has on hand a number of jars of this pattern, it is best to use them for preserves or for canning tomatoes and to purchase the more modern styles for canning other vegetables. In using the screw-top jars be careful to sterilize them first by placing in cold water, bringing to a boil, and boiling for about ten minutes. The rubber and top should also be immersed in boiling water for the same length of time. Remove them from the boiling water when needed, handling as little as possible. Be careful not to put the fingers on the inside of the top or the inner edge of the rubber. Fill the jar with the cooked tomatoes while steaming hot, put on the rubber, screw on the top firmly, invert it, and let it stand in that position until cool.

Kohl-Rabi

This vegetable resembles the turnip in its habits of growth, although in flavor it more nearly approaches the cauliflower. It is grown in many sections of the North, but in the South it is almost unknown Prepare it as you would turnips, pack in the jar, and sterilize.

Lima Beans

Lima beans lose their flavor very quickly after being shelled; therefore it is necessary to can them as soon as possible after gathering. Discard all pods that have begun to harden, and proceed as you would with corn.

Pumpkin or Winter Squash

If provided with a warm, dry cellar, one may keep certain varieties of these vegetables all winter. Some of the best varieties, however, do not keep well, and even the best keepers when not properly housed begin to decay in December or January. It is then necessary to can them in order to save them. If one has a limited number of jars, it is a good plan to fill them all with other vegetables dur-

ing the summer and upon the approach of frost to gather the pumpkins and bring them indoors. By the time the pumpkins begin to spoil, enough jars will be emptied to hold them. They can now be steamed and canned in the same way as summer squash. In this way a supply of jars may be made to do double service.

Succotash

The writer has found that a mixture of corn and lima beans, or succotash, is one of the most difficult things to keep. This furnishes one of the very best mediums for bacterial growth; so extreme care must be taken in the process of canning. It is advisable to gather the corn and beans early in the morning and prepare and sterilize them in the manner already described. As with summer squash, it is best to boil for an hour and a half, instead of for an hour.

Vegetable Roast

A rather unusual dish for the winter may be made by canning a mixture of vegetables. Prepare corn, lima beans, tomatoes, string beans, okra, squash, and egg plant as you would for canning separately. Mix these in varying proportions, letting the corn and lima beans predominate. Add two or three midium-sized onions to each quart of this mixture and run all through a food chopper in order to mix it thoroughly. Pack into jars and sterilize. In preparing for the table mix with an equal volume of bread crumbs, a piece of butter the size of a walnut, and one egg; season to taste with pepper and salt, and bake in a round baking dish until brown. Cut into slices as you would a cake and serve hot with a drawn butter sauce.

Corn, okra, and tomatoes, mixed in equal proportions, may be canned in this way as a soup stock.

Freshness of Flavor and Color

Vegetables when canned properly should retain their attractive color and lose very little of their flavor. It will be found almost impossible to detect any difference either in taste or in appearance between the canned and the fresh article if these directions are carefully followed. The volatile oils which give flavor to most vegetables are not lost during this process of sterilization. Cooking for *three short periods* in a *closed* container at a comparatively low temperature instead of cooking for one short period at a high temperature or for *one long period* in an *open* vessel makes the vital difference and insures freshness of flavor and color. After the jars have been sterilized and tested, they should be kept in the dark, as the sunlight will soon destroy the color of the vegetable.

How to Open a Jar

Jars of vegetables are sometimes hard to open, unless it is done in just the right way. Run a thin knife blade under the rubber, next to the jar, and press against it firmly. This will usually let in enough air to release the pressure on the top. In case it does not, place the jar in a deep saucepan of cold water, bring to a boil, and keep it boiling for a few minutes. The jar will then open easily.

Cautions

These directions for canning apply only to pint and quart jars. If half-gallon jars are used, always increase the time of boiling, making it an hour and a half instead of one hour.

Do not go into canning too deeply at first. Experiment with a few jars in the early part of the season and see if they keep well. It is not a difficult matter to can vegetables properly. The writer has never lost a can of string beans, okra, egg plant, carrots, parsnips, lima beans, beets, asparagus, or pumpkin in several years' experience and, has had only one can of peas spoil, a few cans of corn during the earlier trials, and a few cans of succotash. Any housewife can do equally well. If you follow the directions here given carefully, you will have no difficulty whatever. If you should happen to fail in the first trial, rest assured that you have done something wrong or left something undone. No housewife who has on hand during the winter a supply of home-canned vegetables ready to serve on ten minutes' notice will ever regret the trouble or difficulties experienced in learning.

J. F. BEAZEALE,
Bureau of Chemistry, U. S. Department of Agriculture.

Amount and Value of Canned and Dried Fruit in the United States

* PRODUCT	1909	1904	1899
Total value	$157,101,201	$130,465,976	$99,335,464
Fruits and Vegetables.			
Value	$86,422,383	$72,998,756	$44,802,665
Canned Vegetables:			
Cases	32,834,820	29,579,616	19,323,730
Value	$51,568,914	$45,610,993	$28,734,598
Tomatoes—			
Cases	12,980,818	9,411,084	8,700,538
Value	$18,747,941	$14,020,846	$13,666,560
Corn—			
Cases	7,451,265	11,209,597	6,336,984
Value	$10,332,136	$15,952,386	$8,191,383
Peas—			
Cases	5,901,703	4,694,492	2,543,722
Value	$10,247,363	$7,928,791	$4,465,673
Beans—			
Cases	3,393,200	2,588,015	1,493,517
Value	$6,013,098	$4,133,810	$2,025,123
Asparagus—			
Cases	229,742	....	....
Value	$1,975,775	....	....
Pumpkins—			
Cases	438,426	246,557	138,078
Value	$576,043	$346,497	$202,404
Sweet Potatoes—			
Cases	347,186	192,997	83,526
Value	$531,651	$284,385	$124,245
All Other—			
Cases	2,092,470	1,236,874	27,365
Value	$3,144,907	$2,944,278	$59,210
Canned Fruits:			
Cases	5,461,233	4,628,241	4,467,817
Value	$12,938,474	$11,722,979	$11,311,062
Peaches—			
Cases	1,484,808	1,304,867	1,449,356
Value	$3,753,698	$3,902,441	$4,283,165
Apples—			
Cases	1,205,774	490,341	645,762
Value	$1,898,720	$738,013	$1,125,119
Apricots—			
Cases	562,811	539,815	531,648
Value	$1,825,311	$1,641,919	$1,583,252
Peas—			
Cases	641,291	789,120	672,485
Value	$1,833,214	$2,192,910	$2,188,201
Berries—			
Cases	830,324	489,637	600,419
Value	$1,783,026	$1,058,659	$1,092,975
Cherries—			
Cases	382,116	319,350	114,367
Value	$990,914	$825,522	$307,788
All Other—			
Cases	354,109	695,111	453,780
Value	$853,591	$1,363,515	$730,562
Dried Fruits—			
Pounds	484,328.767	343,579.623	85,439,406
Value	$21,914,995	$15,664,784	$4,757,005
Raisins—			
Pounds	195.774.767	121.409.881	14,984.221
Value	$6,912,533	$6,349,381	$1,062,268
Prunes—			
Pounds	138,498.490	117.808.181	25.413.763
Value	$5,130,412	$3,299,628	$970,927
Apples—			
Pounds	44,568.244	40.737.089	33,212,309
Value	$3,098,095	$1,758,610	$1,906,642
Peaches—			
Pounds	46,843,391	25,861,074	5.662,390
Value	$2,423,083	$1,702,205	$312,495
Apricots—			
Pounds	29,205,569	19,559,573	5.465,217
Value	$2,277,177	$1,410,838	$455,394
All Other—			
Pounds	29,438,306	18,203.825	701.509
Value	$2,073,695	$1,144,122	$49.276

Of factory dried fruit California produced $18,212,316, or 83.1 per cent of the total value of this class of products.

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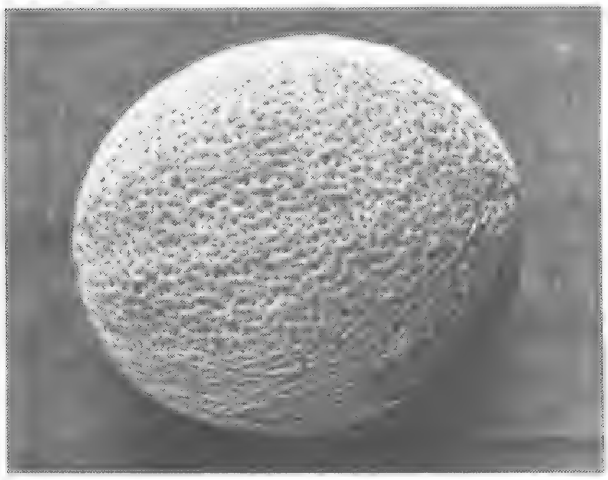
* Census Bulletin of Manufactures, 1913.

Cantaloup Culture



Introduction

The cantaloup in its season is probably the most popular fruit on the American table, appearing prominently on every first-class menu.

The total consumption in the United States, amounting to ten thousands of carloads, besides the local home-grown product which can hardly be estimated, indicates an industry of great importance.

From the growers' standpoint, however, the story of the melon industry is filled with disappointment and failures, difficulties and disheartening returns, which are all but discouraging at times, yet each season some growers are making a decided success of the crop, either through a better experience, more favorable conditions, or exceptional opportunities. Although the grower himself may not always realize the determining elements of his success yet to a careful observer it is evident that many of the factors that cause failures in cantaloupes could be overcome by a better grasp of essential points; for instance, a better knowledge of the experience of other growers, a fuller understanding of the needs of the markets, the best methods of harvesting and handling the crop, and the most favorable system of marketing for the highest returns.

The various cantaloup districts of the United States have been canvassed for any new information on cantaloupes, and this information has been embodied in this article covering the most essential points in regard to good seed, cultural care, harvesting and marketing, also experience and suggestions on insects and plant diseases.

Points for Commercial Growers to Consider

In order that preparation may be made for a better appreciation and understanding of some of the determining factors that may result in success or failure in cantaloup growing consideration is asked of the following questions:

First, Are your seasons long enough, and the climatic conditions favorable for cantaloup growing?

Second, Are you accessible to markets, or good railroad facilities?

Third, Will your cantaloupes come in competition with those from other districts and cause a glutted market?

Fourth, Have you some peculiar advantages which will enable you to meet competition?

Fifth, Have you had experience in handling cantaloupes, and do you realize that it requires under favorable conditions 100 to 150 acres to profitably ship in carload lots?

Sixth, Have you any marketing agencies to assist in disposing of your crop, or will you depend upon open consignments?

Seventh, Have you considered your market demands as to varieties, and do you know what strains of seed would be best adapted to your conditions?

Eighth, What importance do you place on good seed breeding? Do you know that common, ordinary seed may produce as fine specimens as the best seed, but that the well bred seed *will* produce a greater per cent of uniform, marketable cantaloupes?

Ninth, Are you aware that the highest grade of seed can not insure you a crop under adverse conditions, of weather, poor soil or careless management?

Tenth, Do you realize that one failure, or even several, does not prove that success is not possible?

It is not our purpose to call attention to all the possibilities of failures nor suggest all the points of encouragement, but if a grower can realize the essential

points, we feel that the cantaloup industry will be on a more stable footing.

In the first place the large acreage for an individual grower should be discouraged, except in the special cantaloupe growing districts where growers have had experience in handling large acreages. If a large acreage is required to make carload shipments, it would be best to have an aggregation of a large number of small acreages handled by individuals working in co-operation.

Specialized cantaloup growing has been made a success in a few localities by a large number of growers, but has been attended with ups and downs, of overproduction and glutted markets. But there is a great opportunity for a few growers in a great many localities to specialize in cantaloupes, to work up a fancy trade, and to study to cater to that trade and supply them with only the best, that will result in success where now only indifferent results are secured. The grower who considers only the producing side of the industry has not measured one-half of the question, for marketing to a profit is the biggest side.

The Importance of Good Seed

It is often argued that seed saved from over-ripe cantaloupes are just as good for seed, which on first thought might seem true, but why is a cantaloup over-ripe, when the fields have been picked over twice each day as they should be? It is true it may have been overlooked, but more probably the majority of "over-ripes" are so because there is an inherent weakness toward rapid ripening, in reality a poor keeping quality; hence if we plant seed saved from over-ripe cantaloupes that are culled from where the bulk of the cantaloupes are marketed, we are propagating just the traits that we do not want in our cantaloupes for market.

Seed breeding means more than the selection of seed from an average crop; *that would tend only to produce average results.*

The same laws that govern the breeding of animals also control the improvement of plants. Any fair-minded man will acknowledge that thoroughbred animals are more profitable than scrubs, or even average stock, and the same is true of plants. But we must get the true conception of seed selection—not the idea of the uninformed farmer who, with his wife spent their evenings for many days selecting seed corn from a lot of shelled corn that he had purchased for feed. The man who selects his cantaloupe seed at the packing shed is almost as far wrong, for the *plant* that produced the seed has not been considered.

Nature makes selections that the grower may often overlook; for instance, cool nights and a short season will act as a natural selection to develop the early maturing types, hence the seed from the arid region in high altitudes has proven to be superior to seed growing in the humid sections, both for vigor and early maturity. The big cantaloup growers from California and the Southern states realize this, for they look to Rocky Ford each year for their cantaloup seed, and all testify that they get earlier and more uniform cantaloupes from the Rocky Ford grown seed.

Yet because cantaloupes from Colorado are the last to appear on the markets, some might suppose that the seed from there would be late in maturing, when in fact the very opposite is true.

Some Points That Seeds Will Not Overcome

Poor results are often attributed to poor seed, which is doubtless often the case, but there is evidence to show that complaints about seed may sometimes be made when the trouble is due to other causes; for instance, two fields may be planted with the same stock of seed, but having different soil fertility, or cultural care, may show widely different results in yield, size and uniformity of the crop.

As for example, a grower in Texas who complained that certain seed produced too many "jumbo" sizes, while from Southwest Arkansas another complaint from the same strain of seed was to the effect that the cantaloupes were running too small, yet this grower admitted that

dry weather checked his vines somewhat.

Some people seem to think that the crop should show absolute uniformity; this is next to impossible, although a study of the ideal representations and the elaborate descriptions in some of the seed catalogues might convey this impression. *The fact is, cantaloupes do vary even in the best strains of seed;* one can frequently find on one vine, one cantaloup that is very long, while another may be short and round; this is especially true if the vine has made an unusual growth on account of rich soil or other favorable conditions.

The size of the cavity, the development of the netting, and the appearance of the cantaloupes will vary on different types of soil to some extent, and different seasons will lead the grower to think that the seed was not up to standard of the year before when the seed was equally good, but the season was not as favorable in some respects that this grower overlooks. The same seed out of the same sack has been planted on different days, one just before a rain that was cold and the other after it had warmed up; one came up slowly, small and puny, while the other made a fine growth.

Any influence that tends to retard or stimulate the growth of the vines will also, in some way or another, affect the results of the crop; such influence may not be serious, possibly only a few oversized melons, making packing a little more difficult, but *one must expect some variations due to environment. These may be favorable or unfavorable, and they may or may not be under the control of the grower.* There is a long list of these factors—character of the soil, fertility, moisture supply, climate, insect pests, plant diseases, and cultural care; all of these must be considered and controlled, if possible, if we would secure the greatest uniformity in results.

Heredity of the seed is another great factor influencing results and one that is often difficult to determine since there are always the two forces, *environment* and *heredity*, at work, and *which of these causes has produced a given effect will often be the question.*

The only fair way to pass judgment upon the merits of a certain stock of seed is to compare its results with those of other seed under exactly the same conditions. It is the only means of reading heredity in any system of plant breeding. The methods of plant breeding for the different crops are essentially the same, namely, a nursery test of the seed from individual plants, selected for given traits, and which are then grown under uniform conditions to determine their relative merit.

Method of Developing High Grade Seeds

The method is to select a large number of individuals, save the seed separately and plant in adjacent plats at the same time, under as uniform conditions as possible, to test out their breeding tendencies—this is called a nursery test.

The individual plant is the unit of variation, and hence should always be made the unit of selection. The results of systematic seed selection have clearly shown that there is a wide variation in different plants from even fairly pure seed, and that the more nearly a strain of seed can be the progeny from a single plant, the more uniform and strong its hereditary tendencies will be, provided that the individual plant is not a hybrid, in which case it may break up into a variety of types; but even in long established strains of pure bred seed there is still the continual "reverting" or "breeding back," so that it is not uncommon to find a cantaloup that is a little "off," so if the general average of the crop is pretty uniformly true, one need not suspect a mixture by the appearance of a little variation.

Sometimes a variation is along very desirable lines, for there are numerous instances where the selection of the seed from a single plant that seemed different, has been the beginning of a new strain much superior to the original; such was the history of the disease-resistant Pollock cantaloup, while the

Ryan's Early Watters was started from a single early maturing plant.

There is plenty of seed saving, but comparatively little seed selection along systematic lines, and there is still less seed breeding for improved hereditary traits. Usually twenty-five hills are planted in each plat, and all are given uniform conditions that the differences that may develop may reasonably be ascribed to heredity, and the new selections made accordingly.

A number of the choicest individual fruits from the most desirable plats are again saved for the next year's nursery test, and the plats that run most uniformly alike along desirable lines, are then cut for stock seed. In this way the weak traits and undesirable tendencies of any individual plant may be eliminated more and more each year, while the strong desirable traits are retained and thus the average uniformity gradually increased as far as possible.

It will readily be seen that it requires the same care to maintain a grade of quality that it did to build it up in the first place, *the tendency to deteriorate being always present.*

The first nursery grown, before the seed had been bred up much, would have the appearance of a large checker board, because of the many variations. Some would be disease-resistant and some not; some would be early and some late; some prolific and others not, while in netting, color of the flesh, and the size and form of the fruit, the contrasts would be also very marked.

Aside from improving and combining desirable traits, *the nursery test* for cantaloupes has another strong point of merit, namely, *keeping the stock seed pure.* It is evident that if seed from individual cantaloupes are planted separately in different plats, it would be easy for a keen observer to detect the presence of a hybrid and thus eliminate that plant from being saved for stock seed.

So marked have been the results and advantages of the breeding from individual plants to secure uniformity and desirable traits, that no one who has followed it up intelligently can doubt the efficiency of the method; but at the same time it is very evident that it takes care and a good deal of time to accomplish results which at first may seem easy.

Seed breeding is practical; it is not a theory or a fancy, but a reasonable, result-producing process. The most successful farmers are giving it careful consideration, nor does the improvement of seed add a burden of labor and expense, but comes as an added asset to the grower's wealth, and increases his pride in his crop.

Comparatively few men are capable of producing their seed for if they are growing cantaloupes for market, their time and attention must be occupied with the crop, and to select, cut and cure high-grade cantaloup seed requires no little *training and experience*, and some little equipment.

The grower who buys his seed should deal directly with a reliable breeder who is qualified, and is making a specialty of growing the crop for seed; a grower should not submit his seed order for *"lowest bid"* if he expects to get the best seed.

Conditions and Cultural Care

Climate

The cantaloup seems to thrive in rather a wide range of soil and climatic conditions, being grown to some extent in almost all of the states, although from the standpoint of money returns, the area of very successful cantaloup culture is somewhat limited; yet it appears that it is more the question of cultural care, disease and insect pests, or favorable marketing facilities, which determine the success of the industry in a given locality, rather than the specific soil or climatic conditions.

Climatic conditions within certain limits are essential to successful cantaloup culture, and the consideration of this topic may answer many questions as to the adaptability of some sections for melon growing. First, there should be a *long, hot summer*, with about five months free from killing frosts, with a

daily maximum temperature between 80 and 95 degrees during June, July and August, with a night temperature seldom falling below 60 degrees; four months may mature good cantaloupes, but with so short a season frost would probably cut short the profits of the crop, unless, as is done in some of the Northern states having too short season, the plants are started under frames in sods or paper bands; second, there should be plenty of bright sunshine, without excessive rainfalls; this will secure good quality and lessen liability to attacks of fungus troubles that are so often fatal to the melon crop in rainy sections or regions of heavy dews; without doubt the clear bright sunshine and the arid conditions of Southeastern Colorado account for the high flavor and the fine qualities found in the Rocky Ford cantaloupes as compared with the poor quality in the cantaloupes with an abnormal rain fall, which sometimes occurs.

Sunlight is very essential to the full development of cantaloupes, for the quality is perceptibly inferior in shaded spots; the dry atmospheric conditions cause rapid transpiration of the moisture from the leaves, thus inducing a quick movement of sap or plant juices which increases the power to carry and deposit plant foods, thus developing and concentrating the spice of flavor and producing the very highest qualities.

We do not recommend cantaloupes to be planted in an orchard where there is any shade to speak of, as they will not do well.

Plate No. 2. Contrast in Growth of Vines; on the Left Alfalfa Sod; on the Right Old Land.

Soil and Fertility

It is conceded by all experienced cantaloup growers that the cantaloup thrives best in a warm, sandy loam; clay loam and other types of soil may produce a good crop if the tilth and fertility are good, but heavy soils are apt to be cold and backward, causing lateness in maturing, and it is also generally believed that the nature of some types of soils seriously influences the form, size and other qualities of the cantaloup. It is true, however, that the average size will vary in different seasons; in seasons of very favorable growth the cantaloupes will run to a large proportion of "jumbo melons" (larger than standard); in seasons less favorable there will be more small or pony sizes. An actual test of a crop on a piece of land is the *best* proof of the fitness of the soil for that crop, for while a chemical analysis may theoretically seem favorable, in practice it may prove otherwise.

There are many factors that may influence the results, but in general the land that will grow other vine crops, such as cucumbers, pumpkins and squash, will probably grow good cantaloupes.

Soil for cantaloupes should have good drainage, both surface and subsoil, and in irrigated regions the land must have a uniform slope or grade so that the water will run even, without soaking or flooding the hills; if there is one point above another in cantaloup culture that needs special emphasis, it is the caution against *oversoaking* or *flooding* of the surface of the field; this will be further discussed under the topic "Irrigation," but the point must be held in mind in many of the operations, and in selecting the field, to have it well drained on the surface as well as the subsoil.

If no detrimental soil conditions like seepage, or alkali, exist, the question of fertility is usually the most important one in relation to the soil; barnyard manure is an old standby, and cantaloupes, of all crops, will respond as well to well-rotted compost as to any form of commercial fertilizer, but experience of the most convincing sort has

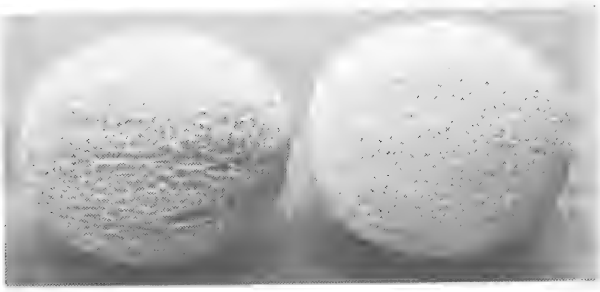


Plate No. 3. The Contrast Between an Imperfect and a Perfect Cantaloup.

shown that soil cannot be made to produce good cantaloupes indefinitely, year after year, by applying manure and artificial fertilizers.

Aside from fertility there are also the questions of plant diseases, soil bacteria, and unbalanced food supply. *Crop-rotation* has proven to be the most practical and adequate means of preserving not only the proper fertility, but the nearest approach to securing uninfested soil conditions, hence crop rotation becomes an important phase of cantaloup culture

Alfalfa to the western ranches occupies the same place that clover does to the eastern farmer, or the cow pea to the southern planter; these crops for their respective sections provide ideal soil fertility and tilth for the cantaloup. In Colorado alfalfa sod is the ideal soil preparation for cantaloupes, and a comparison of the results on alfalfa sod with even well manured old land will convince the most skeptical. (Plate No. 2.) Experience has demonstrated that early matured cantaloupes can hardly be expected on soil following a heavy fertility consuming crop, like sugar beets or corn, a good *late crop* being the usual result. Nearly all the fine records of early yields and high prices have been made on soil that was in a perfect state of tilth and fertility.

Soil *can* be made *too rich* in applying manures, and the principal point in the application of fertilizers is to have a reasonable amount, and well incorporated in the soil, and in the case of barnyard manure to have it well rotted. In Colorado manuring in the hill has been found to have no advantage over the broadcast method, owing probably to the wide spreading root system of the plant; *commercial fertilizers have not been profitably used in Colorado.*

Preparing Land for Cantaloupes

The secret of getting soil in that ashy, mellow condition so desirable for cantaloupes, is one largely of experience, for handling soil in the same manner on different farms will seldom get the same results; one may be a clay, the other a sandy loam. The texture and the previous cropping has much to do with the way the soil can be handled. In general there must be moisture in the soil during the winter to secure the mellowing effect of the frost, and the soil *must not* be handled too wet. If clay or adobe "packs" it will dry hard and lumpy; real sandy soil can be handled wet with less risks than other soils. The soil should be friable so that the harrow will pulverize it without clogging as it does in mud, and yet not so dry as to leave the field full of clods.

Before plowing the soil should be well disked for two reasons. First, to thoroughly mix the soil with any fertilizer previously applied, and, second, to pulverize the soil on the surface, so that after the work of preparation is complete, the bottom of the furrow will be as finely prepared as the top. Plowing for cantaloupes is usually made to the depth of five to six inches; in the arid region the plowed land must be closely harrowed behind the plow, to prevent too rapid drying of the surface, and should be closed up by fining the soil on top; this is usually accomplished with the steel harrow with the teeth turned nearly flat, or with a float or land-leveler. A fine dust mulch will check evaporation, and

Plate No. 4. Leveling Land, and Fining the Soil.

thus conserve the soil moisture, to enable a more thorough harrowing to complete the preparation. Preparing the land some time before planting is advisable, as the soil becomes settled and the seed will germinate more readily and a more uniform stand will be secured. The soil should also be harrowed after *cold spring rains* to check evaporation, which will tend to aid in warming up the soil. Before laying out the rows to plant, while the surface of the soil is dry, the field should be carefully leveled with a land leveler (see Plate No. 4), removing all the high points and filling the hollows and dead furrows so that in irrigating the water will run uniformly without flooding the rows, or oversoaking any of the hills.

About planting time the field is laid off with a marker in rows five to six feet apart, in the opposite direction to the rows to be planted, which are laid off with the irrigation furrows in the best direction for water to run. The irrigation rows are usually made about the same distance apart, usually six feet; these furrows can be made with a single shovel plow or a two-row marker or furrower. In the non-irrigated regions these furrows could serve for surface drainage after heavy rains.

Planting and Securing a Stand

The first requisite in planting cantaloupes is to have the weather *warm*, for warmth and moisture are the two essentials in seed germination. Many growers make the mistake of planting while the ground is yet cold with freezing temperature occurring every few nights. If perchance the days are warm enough to germinate the seed, the plants are stunted and make a slow, tantalizing growth, should they be so fortunate as to escape these late frosts of spring.

As a general rule, a few days before the latest freeze may be expected, is as early as is safe to plant. It is *common* for cantaloupes planted as early as the tenth of May to begin to ripen as soon as the earlier planted seed, so as a rule it is not to much advantage to plant very early; the *grower* must be the judge in regard to his soil and climate.

There are two systems of planting cantaloupes—the *drill-row* and in hills. In the hill system the field is check-rowed like corn, to permit cultivating in each direction, the rows usually being laid off five to six feet apart, and the hills about the same distance in the rows. By dropping eight to ten seed to the hill, it will require about a pound of seed to plant an acre. It is advisable to plant plenty of seed in order to secure a good stand, allowing for the attacks of the cutworms and other destructive agencies.

There are two methods of planting cantaloupes in hills—with a hoe, and with a hand planter, commonly called a "snapper." The rotary type of this form of planter is usually the most satisfactory, but some modifications are usually necessary to fit it for dropping cantaloup seed.

By filling the holes of one of the regular corn-dropping plates with lead, then by boring out with a three-eighths drill

Plate No. 5. Planting Cantaloupes with Garden Drill.

bit and by testing and enlarging the holes it can be regulated to drop quite well; the seed box will also need close fitting, to prevent the thin flat seed from leaking out. A block or stop should be attached to the blades at about the depth to plant, about one and a half inches; this will insure uniform depth, which is essential. Great care should be exercised to have the depression or hole formed in the soil by the thrust of the planter filled or leveled with the foot; otherwise the seed will dry out, field mice will more

readily find the hills, and a hard dash of rain will form a hard chunk, or crust, right over the seed. The surface of the soil should be *dry* to insure good work with the planter. A man with some experience can plant from three to five acres per day with a planter, while one acre per day is about all that can be accomplished with a hoe.

The principal argument for the hill system of growing cantaloupes is the economy of labor, for more of the weeding and hoeing can be done with a horse.

In the drill system the rows are usually put about the same distance apart, but the seed are sown in drill rows, the seed being dropped every two or three inches; this method requires about two to three pounds of seed per acre. The seed is sown either with a hand drill, shown in Plate No. 5, the horse planter, or the sugar beet drill is used. The important point is to get the seed dropped uniformly, and the drill set to plant at a uniform depth — not over one and a half inches; as soon as the plants are nicely up they should be thinned to single plants, far enough apart to permit hoeing between. After the danger from insect injuries is over, and about the time the first blossoms appear, the plants should be thinned again to one plant every two feet, on the average; the tendency at this point is to leave the plants too thick, especially if the plants are extra fine. The most advanced plants are selected, which is the cause of the drilled fields usually maturing earlier than the hill planted, and the earlier development usually compensates for the extra cost of the increased amount of seed, and the added labor of thinning.

The essential points in planting are to get the seed planted at a uniform depth, and at a uniform distance from the irrigation furrow; to have the soil fine and firmed just right, to skillfully conserve and apply moisture, and to keep a crust from interfering with the young seedlings.

In the arid regions the seed is usually planted about one-half inch deeper than it is expected the plants will come through, in order to hold the moisture line to the seed. When the seed is well sprouted the hills are raked off with a garden rake, removing the crust and any clods that might interfere. Sometimes the field is harrowed across the rows with good results, especially where the rows are drilled in. This matter of "raking off" and keeping the surface fine over the hills is a *very important point* to be observed in securing a good stand.

Irrigation

The moisture problem in cantaloup growing is a very important one. Some times in the humid sections, there is too much water, and it becomes the question of how to save the crop; but little can be said here, except to select well drained fields for the cantaloupes and provide the field with furrows, like the irrigation furrow, to carry off the excess rain water, and to plant on somewhat raised hills or ridges.

In the arid sections the moisture for the crop as a rule depends on the irrigation furrow, and the skill of the grower to so manipulate the soil and water. Too many look upon irrigation as a simple process of running water through the rows, or over the ground, paying little or no attention to the *needs* or *demands* or the dangers of flooding or oversoaking the land. When soil is completely saturated with water the air is practically all driven out and the soil settles, which defeats the very object and purpose of plowing and the other work of soil preparation, which will dry hard and nothing but frost can ever mellow it as before.

The application of water to all such crops as cantaloupes should be by subirrigation, that is, the moisture should soak through the soil to the plant or seed, from the irrigation furrow, without the surface of the soil, except in the furrows coming in contact with the water; this is essential not only for the needs of the plant but also the same amount of water will serve a longer time the needs of the plants, the water rights in some ditches making it necessary to conserve the moisture as long as possible.

In order to supply the moisture uniformly to the seed along the row, the seed must have been planted at a uniform distance from the water line, about four to six inches; to insure uniformity in the soaking of the rows, the rows should be "logged" out, or smoothed out with a short piece of log about the size of the furrow; this will cause the water to run through quickly, and by regulating the amount in each row, the rows will become uniformly wet without flooding or soaking the ground. Plate No. 6 shows

Plate No. 6. Irrigating for Germination of Seed.

a field being properly irrigated, to germinate the seed. When the water can be gotten through the rows quickly and the amount regulated to supply the rows about as fast as it soaks in the soil, the upper and lower parts of the row will become wet at about the same time and amount, with practically little water wasted.

The idea is to soak the rows until the water has fully reached the seed, while the surface over the hill remains nearly dry; this is *ideal condition* for *germination* and is sufficient for the needs of the plants in all the early irrigations. Later the rows can be soaked till moisture shows on the surface back to the plants.

Under arid conditions one irrigation after planting, and one again about the time the plants are coming up, is ordinarily all that is required until after the first cultivation; after that irrigation and cultivation alternate each other every week or ten days, the exact number of times depending on the weather and soil conditions.

The amount of irrigation necessary to secure the best results in cantaloup culture, is subject to so many varying factors, that it is impossible to lay down an exact rule. In the first place, the cantaloup does not thrive in a wet soil, as evidenced by the injury and poor quality of the crop in seasons of excessive rain. The needs of the crop in the first stages are very small, and as light watering as possible to secure the needed moisture is best; then as the plant develops the amount of irrigation should be increased; *light, frequent irrigations* rather than heavy soakings at long intervals has proven to be the best plan.

When the vines are nearly grown and set full of developing fruit a heavier irrigation is then needed by the plant, but as soon as the fruits have reached their growth, light waterings should again be the rule; to insure the best quality, little if any irrigation should be applied during the picking season, just enough to prevent severe wilting; it is at this time that the cantaloup "rust" fungus makes its appearance, and moisture and dews are favorable to its development.

The dryer the season, the better the quality in cantaloupes, is an axiom that should induce more careful irrigation among cantaloup growers in the irrigated sections.

The relation of irrigation to early setting of cantaloupes is a somewhat mooted question; there are growers who argue the use of frequent irrigations during the setting period in order to secure a good set, but others prefer to keep their vines dry, even allowing them to show the need of moisture before they will permit irrigation during this stage.

It is evident that the season and climatic conditions have more to do with the setting of fruit than the watering; there are experiences that might seem to support both theories; yet continued observations would indicate that a grower is not warranted in following either course to the extreme, but rather the medium plan of providing just enough moisture to secure an even, healthy growth all the way through, would seem to be most favorable condition.

An excess of water in hot weather is apt to induce a heavy growth of vine at the expense of early "sets" due to the

rank growth, and such succulent growth is also much more liable to succumb to the attack of diseases and insect pests.

Hoeing

Hoeing the hills is of great importance, but it should be done with skill both as to the time and in the manner it is done, for careless hoeing is a common error; if the seed has been properly planted in mellow soil and the irrigation properly applied, there is no reason for deep hoeing in and close to the hill, as it only disturbs the plant and dries out the soil; weeds can be destroyed by rather shallow hoeing.

The dry, cloddy soil on the surface of the hill should be removed and replaced with fine mellow soil drawn up *from away from the hill,* hilling up the plants as much as possible; even to almost covering the two seed leaves. This will protect the plants from wind and insects to a large measure; but the most important feature of this process is the holding of the moisture well upon the stems, affording the best condition for a long base for the development of the roots, as well as supplying the plant with moisture. If, on the other hand, the soil in the hill is loosened up with the hoe and not hilled up by drawing the loosened soil to the plant with the hoe, the hill will usually dry out, and only a short portion of the stem be in moist soil to induce root development.

Cultivation

A thorough preparation of the soil before it is planted to cantaloupes will very much lessen the necessity for so much cultivation afterwards, but a good deal depends on frequent and thorough tillage during the early stages of the growth of cantaloupes; at first it should be deep and thorough, but not close enough to disturb the plants; the cultivations should be more shallow and further from the hills as the plants develop. The grower who cultivates deep and close to the hill because the vines do not prevent this, is cutting off roots, setting back his crop more than he is doing good. He should understand the growth of the roots, for they form the counterpart of the vines on the surface, only they ramify the soil more thoroughly and to a greater distance than the length of the vines, so it is easily possible to damage the crop by careless cultivation. Examinations in the soil between the rows will reveal the tiny rootlets very thick, four to five inches deep, hence surface tillage after the vines start should be the rule; in irrigated regions root pruning seems to be detrimental to the crop.

In the humid areas of the South under heavy rain falls, experienced growers recommend deeper planting and deep, thorough cultivations. They argue that deep cultivation will induce a deep root system, so if the season is excessively wet, the deep stirring will dry out the ground faster, and the root pruning will have the effect of checking the too rapid growth of vines that usually accompanies wet conditions and hot weather, and when, on the other hand, the season proves to be a dry one, the heavy soil mulch will conserve moisture in the subsoil, and the deep root system will permit the plants to develop a good crop, while on the shallow stirred soil the crop will burn up.

Tools Used in Cantaloup Culture

The fourteen-toothed cultivator, with a steel weeding knife bolted across between the two back teeth, so as to run just below the surface an inch or two, has become the most popular tool for cultivating on land clean of alfalfa roots or trash. This gives ideal tillage, and practically kills all the weeds except in the hills.

On alfalfa sod where the crowns would gather on the knife it is not so pleasant to use, yet it will do very satisfactory work, but here the five-toothed cultivator is usually used; this tool is also used to furrow out rows by closing it up and placing a large shovel on the rear shank. When the cantaloupes are "laid by" (cultivated and furrowed out the last time), the irrigating furrows are made somewhat larger than before and they should be "logged out," so that water can make its way through the rows after the vines have covered the ditches; it is also a good plan to lay the vines around out of the furrows once, to train them as much as

Plate No. 7. The Common Tools Used in Cantaloup Culture.

possible away from the furrows; this will keep many of the cantaloupes out of the ditch, though the vines will eventually nearly cover the ground.

A two-horse ten-toothed riding corn cultivator makes a splendid tool for large acreage.

General Care of the Crop

If there is a secret in getting early cantaloupes, it is in growing them from start to finish in such a way that the growth is not checked at any time. The cantaloup does not seem to have the power to rally from a check in growth or an injury of any kind; the setback not only hinders the production of early fruits, but seriously affects the size and yield of the cantaloupes. There are numerous instances where unfavorable conditions of some kind have checked the growth in some part of a field that was planted and otherwise handled the same; invariably that portion of the field will show marked difference in size, netting or other qualities. The best promise of a good crop is a prompt and steady growth from germination to maturity.

The seedling period is the critical time in the development of a crop of cantaloupes, for it is at this stage that the check in growth usually occurs from cold weather, high winds, lack of moisture or the attacks of insects.

A knowledge of the manner of growth of the root system and development of the seedling, will in a measure explain the reasons for the steps taken and the precautions that are necessary at this time in handling the crop through this important period.

The root system that first develops when the seed germinates, penetrates almost directly down from the seed while the stem or radical is pushing its way to the surface. These little roots seem to form a temporary support for the plant during the first two or three weeks, for up to this time the stem from the seed point to the top of the ground is smooth and white, with no evidence of the lateral roots.

The second root system develops from the stem about the time the fifth leaf appears, or four to five weeks after germination; these roots seem to form the main feeders of the plant, for the growth of the plant is almost insignificant until it feels the impulse of this larger and better root system. The question of good early growth and maturity almost hinges on the success of the farmer in supplying the conditions that will favor the early and proper development of this lateral, or main root system. It seems evident that the depth of planting and the manner of managing the soil in the hill has an important relation to the early development of these lateral roots. Experience teaches that seeds planted much over two inches in depth are slow and difficult to germinate, being weakened by the long stem that is necessary to reach the surface; and, on the other hand, if planting is too shallow, the seeds are apt to dry out, or if rain follows a crust will form, which must be removed, and that often exposes the seeds that are not planted at a sufficient depth, with fatal results, or leaves the plant with too shallow a stem support; it is then whipped and wrung by the high, drying winds or exposed to the attacks of the cucumber beetle.

Seed will germinate readily when weather conditions are favorable, if planted at about the depth of one and one-half inches.

When the seed leaves are nearly to the surface the hills should be raked off, removing any crust or dry lumps which may obstruct the little melon plant. Plenty of seed should be used to provide against a loss in handling the hills, or from the attacks of insects. It also affords a chance to select the thriftiest in-

dividual plants when the thinning is done. Owing to the injuries from the striped cucumber beetle, the thinning should be delayed until the plants have about the fifth leaf, when the beetle will not do much more injury; the extra plants in the hill should be destroyed by pinching or cutting off the stems, as pulling them out may disturb the plants to be left.

Insect Enemies

No sooner has the seed germinated than the struggle for existence begins; an effectual precaution is to plant plenty of seed scattering it well in the hill, and even replanting before it is evidently necessary—usually some replanting is required anyway. Crop rotation, also, is often a good way of avoiding infested fields, in fact, "prevention is better than cure," in fighting insects and plant diseases.

The destruction of insect harbors such as weeds, old vines and plants, should be given more consideration, and the cultivation of the fields in the late fall, winter and early spring, will destroy many eggs and insects that pass the winter in the soil—grasshoppers and cutworms, for instance.

The Striped Cucumber Beetle

This little black and yellow striped beetle, about a quarter of an inch long, is doubtless one of the most common melon pests, especially when the plants are young and in the two-leaf stage; long lists of remedies have been tried, but the best that experienced entomologists have to suggest is to spray the little plants as soon as possible with arsenate of lead, at about the usual three pounds to the fifty-gallon formula.

The beetles are not killed by this remedy, but it acts as an efficient repellent. Spraying with the Bordeaux mixture is also recommended, but the Bordeaux is better for the little black flea-beetles when they bother, as they do at times, but they usually work more on the cabbage, radish and turnip. The best means of applying sprays to small plants is the small type of sprayer that can be easily carried over the field, the type that has an air chamber in which pressure is pumped in, and that has a cut-off on the nozzle that works like a trigger, thus allowing the hills to be sprayed with little waste of the material. A very good spray pump of this type is The Brown Auto Spray No. 1, manufactured by The E. C. Brown Co., Rochester, N. Y.

Dusting the hills with air-slacked lime, through a common cheese cloth sack, is an old means of fighting the beetles but is not as effective as the aresenate of lead spray.

The Melon Aphis

The melon aphis is doubtless the most serious pest that the cantaloup has to contend with in many places, and one against which resistance is least effectual where conditions are favorable to the aphis.

Fortunately for the growers the natural enemies of the aphis usually hold them in check quite effectually; the lady-beetle, the Syrphus flies and the lace-winged fly are the principal enemies to the aphis; some seasons a little parasitic fly destroys many aphis.

The only effective measure seems to be a careful watch of the fields to destroy the first plants found to be infected with aphis, as it seems that only a few insects are able to pass the winter, and they seem to spread from a few isolated points, and if these can be destroyed by finding them and burying them, early, this has seemed to be the only plan to adopt, as spraying and fumigation has been tried by the most competent experts with very unsatisfactory results.

Spraying with "Blackleaf 40," one ounce to ten gallons of water, with a little soap, say seven ounces, is the most effective spray where a few hills become infested, but where the whole field becomes infested spraying has proven useless.

The introduction of the natural enemies, like the lady-beetles, has been tried in California with some promise, but this plan is in an experimental stage as yet. The necessity of supplying the enemy as soon as the aphis appears, makes this plan rather impractical for the grower.

Destroying the winter harbor or host

plant of the melon-aphis would seem to be the best measure to adopt, if possible; this winter harbor has not fully been determined for some points.

The Pickle Worm

There have been many complaints from growers in the southern part of the United States of injuries from this worm. Careful inquiry has been made to find the best information on this pest, but there is no known remedy as yet, other than the general precautions of clean farming, rotation of crops and fall plowing; in the more northern melon districts the attacks of this insect are apt to be only periodical, which is true with nearly all insects; they appear in waves; one year they may be very destructive and the next season will hardly be seen, so there is no need of giving up because there have been insect pests one year. The eggs of the larvae of the pickle worm are deposited on the buds and tender shoots of the plants, and as the young worm hatches it feeds in the angles of the stems and leaves, and if the plants were well sprayed with arsenate of lead the first broods would be largely held in check, and subsequent sprays might be profitable.

Plant Diseases

Crop rotation, seed selection, or breeding for disease resistance offer the best means of controlling plant diseases; the spraying of the crop with Bordeaux mixture or other fungicides is about the only other means at hand. In Colorado, spraying has not proven as successful as it is reported to be in other states, doubtless due to different climatic conditions.

Careful control of irrigation seems to offer one means of lessening the attacks of some of the fungus troubles in the arid sections under irrigation.

Harvesting

After all injuries to the crop have been explained and remedial measures suggested, there still remains one great cause of poor returns from the cantaloup crop, viz., *careless and unscrupulous methods of marketing.* When cantaloupes are scarce and sales are quick, there seems to be no power on earth that will stay the hand of the average grower as he pushes his crop onto the market, with the encouragment of advices from his progressive (?) commission merchant; together they have produced a glutted market with inferior products; instead of protecting the markets with a quality that would increase consumption, they simply let it fill up with everything and anything, and neither the grower nor the consumer is benefited. It is common for growers to admit that they are shipping cantaloupes that are not fit to be eaten, and it is not strange that a similar complaint comes from the consumer. Not till the grower is honest with himself, should he expect good returns.

Picking

When green or over-ripe melons are allowed to go onto the markets, the trouble usually is in the picking; careless or mistaken ideas often prevailing. There is a very narrow limit in the stage of ripeness that a cantaloup can be picked and have it in the right condition for distant markets. On one hand, it cannot be picked as green as a tomato or lemon, and still ripen during shipment to fair quality, nor, on the other hand, can it be allowed to show any distinct color of ripeness, like an apple, without it becomes too soft on long shipments.

It should be ripe enough so the flesh will be sweet when cut open, yet too hard to be eaten for a day or two; it requires skill and experience to determine the proper stage.

Jocularly it has been said: "The cantaloup has three stages in three days—green, ripe and rotten." This expresses the fact that there is a very short period for marketing the crop in good condition, yet if picked at the proper stage, and handled right under refrigeration it can be shipped to distant market in quite normal condition.

It is hard to describe to a novice just how to detect the right stage to pick a cantaloup; there is, first, a very slight change of color in the interstices of the netting, hardly enough, however, to attract the attention of the inexperienced; second, it is tried with a pressure of the

thumb and forefinger on the stem, when it should "slip," that is, separate in the same manner as when real ripe, but requiring some little force but not enough to break the stem or flesh out; conditions of the vines and climate will at times vary the picker's judgment to some extent; but by occasionally cutting a melon the point can be decided. It is *very essential* that pickers be *carefully instructed*, and *closely watched*, for the good returns should not be expected from green, or over-ripe cantaloupes.

Packing and Crating

The fruit should be carefully handled, not bruised or roughly shaken to loosen the seed cavity; it should be hurried to the shade and crated as soon as possible; the cantaloupes should be carefully graded before crating, not only as to size, but for condition of ripeness, for there will always be some a little too ripe which must not be crated with the green-ripes, or the markets will suffer. In grading, the ripe melons can often be marketed in local or nearby markets, and the ones just right reserved for the long distance shipments.

In crating the layers must be uniform and tight, but not so crowded as to crush or bruise the flesh, yet there should not be a loose melon in the crate if it is expected to carry well.

In crating, the ends of the crates should be supported on the crating table, so that the slats can spring down in the center of the crate, then when the crate is finished and nailed up there will be no spring of the slats to loosen the pack when the crate is picked up.

Plate No. 8. Three Styles of Packing.

Plate No. 9. Pony and Jumbo Crates. The basket is used in some sections for local trade.

The crate has been the standard package for a long distance haul, but there is a needed reform in the matter of grading and packing cantaloupes, as the old style grading of "pony," "standard" and "jumbo" sizes has proven unsatisfactory. The standard 45-melon crate is good, but the "pony" has included too many immature cantaloupes, and has not been profitable in general and should be discarded. The "jumbo" crate is too heavy to handle well, and often difficult to crate well, when there are only a few cantaloupes that run to the jumbo sizes.

Three styles of crating cantaloupes are illustrated (Plate No. 8) which will prove adequate to handle the marketable cantaloupes in the simplest way; with only two styles of crates required.

The standard sized cantaloupes would be first crated in a regular standard crate 12x12x24, 45 cantaloupes to the crate, then a size larger packed in the same sized crate with 36 cantaloupes to the crate, packed with what is known as the "diamond" pack—as shown in the halftone (Plate No. 8).

The larger jumbo sizes are then to be crated in a flat, one-layer crate with 12 cantaloupes to the crate. This crate would probably need to be about 5x14x24; this would be easy to handle, and popular for private home trade. With this style of grading and packing, there could be just three classifications, "Standard 45s," "Standard 36s" and "flats" and there would be less bruising, trying to crowd large cantaloupes into crates, and handling large unwieldy jumbo crates, besides simplifying the number of different crates.

Plate No. 10. A Convenient Arrangement for Packing.

Marketing

Marketing a crop of cantaloupes to good advantage is probably the most perplexing phase of the industry; we might classify the different methods of marketing in order to consider them:

First, Selling to the Local Trade—There is little to be said on this, other than the grower already knows; good goods, and fair treatment. *Second, Selling on Consignment*—This seems to be like "stepping out into the unknown," there are so many uncertainties. There are several factors to consider here; the growers should be organized, in order to buy crates and load to advantage, they must take pains to find responsible commission men, they must plan to keep in touch with the markets, to know what the market needs and demands, and live up to their end of the deal in shipping only first-class cantaloupes; they should have some plan of co-operation so that in times of limited markets they could prorate the sales or limit the growers to a certain number of crates to be shipped per acre when the market was glutted, and only a certain amount should be sent to the market, as it is better to leave the cantaloupes in the field than to ship and lose the work and still injure the glutted markets.

Probably the greatest encouragement in recent years for the cantaloup growers is the plan of the cantaloup distributors forming an exchange, and co-operating in holding the markets free from glutted conditions. The plan is to have the distributors in a district get together each day and divide or prorate the shipments to certain markets, and not send to any one market more than it is possible for that market to dispose of; this plan was worked to perfection in the Imperial valley in California, and in the Rocky Ford district the season of 1911, and growers everywhere should refuse to deal with a commission firm who would refuse to co-operate in this way—growers' melons have been used to fight their neighbors too long. *Third, Marketing in Transit*—There are several commission firms who make this a specialty in handling the large shipments from the big melon districts; in reality it does not differ from the commission form of selling, only the organization of a marketing system to keep in touch with the different markets and their needs; this could be handled by a competent manager of a large association if it were not for the short season that the cantaloupes are handled from any one district, the large commission firms having the same organization that they can utilize for other products; hence it is doubtful if there is any better plan than to market through some of the well established agencies. *Fourth, Marketing for Cash*—This is the Utopian idea of the growers everywhere, and as long as cantaloupes are selling well it is all right, but when the price goes down the cash buyer is gone.

Strains and Varieties of Cantaloupes
Rocky Ford

There is a prevalent idea that there is a variety of cantaloup known as "Rocky Fords;" strictly, this is erroneous; unless it is a name to embrace the miscellaneous seed that is purchased from Rocky Ford.

The fact is, the *Netted Gem* was the original variety used to develop the Rocky Ford cantaloup industry, but thirty years of selecting and crossing have developed greatly improved types that are distinct and very different in many respects; but there are really only two or three types; one,—the "Pollock," has been renamed "Eden Gem," "Netted Rock," "Rust Resistant" and so on, and the selection ideals

followed by the men exploiting the new names have established slightly different strains of the Pollock. Hence there is a good deal of confusion in regard to Rocky Ford seed.

The markets have a demand for both the *green and salmon-tinted* flesh in the Rocky Ford strains of cantaloupes; this is *entirely distinct* from the orange-colored meat of the *Osage types;* and the growers also demand an extra early strain beside the main crop sort.

Rust-Resistant Pollock, Salmon-Tinted

The original "Pollock" was the result of a hybrid, as running through nearly all the Pollock strains there are the two colors in flesh and various combinations of them — green and salmon-tinted, vine *disease-resistant.*

Rust-Resistant Pollock, Green-Fleshed

The Green-Fleshed Pollock is very similar to the other Pollock, except in the color of the flesh, which runs more green, shading to yellow at the cavity; we would recommend this strain for markets that demand a green-fleshed cantaloup. The general character and appearance of the two strains of Pollock are the same. These two Pollocks are classed as the best late or main crop varieties of Rocky Ford Netted Gems.

The Ryan's Early Watters Strain

There are localities where the early cantaloup is very profitable and there is a demand for an early maturing cantaloup. Ryan's Early Watters meets that demand; this strain holds the best records of high returns on account of its very prolific yields of extra early cantaloupes. In appearance it is almost identical with the Pollock type; it has the green colored flesh, and the same general flavor. The special point in the selection has been *prolific early maturity* This strain germinates very strong, vigorous plants, the fruit sets early, and the crop matures in a very short time, yet is extremely prolific, often making yields of two hundred and fifty crates per acre. It is fully a week earlier than the Pollock strains. Recommended where the tendency to fungus troubles is not too marked, and for a small portion of a grower's plantings it will doubtless pay in many locations.

Early Rust-Resistant, Hybrid

This strain has a remarkable vigor of growth until it has set and developed a large set of fruit and then the growth seems to stop—that is, the new shoots; the vines seeming to throw all the force into the development of the fruit. This trait seems to make it desirable in one point, as it has not been so seriously attacked by the melon aphis as the strains that have plenty of young succulent shoots.

This hybrid is the best early strain by all odds. It is early as the Watters, and almost as disease-enduring as the Pollock strains; it is very prolific, and especially so in producing a heavy yield of the first early sets.

The flesh of this strain is green, the netting exceptionally good; the cantaloupes are rather inclined to be longer in form than our other strains, and is not quite as regular in size, yet its many good qualities make it the most desirable cantaloup to plant for early.

New Strains of Promise

Triple Hybrid No. 3. This melon has an exceedingly heavy close netting, and thick flesh, of a salmon tint at the center, with a deep zone of emerald near the rind. This cantaloup runs rather large, but on account of its exceptionally attractive appearance, we believe it would be valuable to market growers, especially for local trade.

The Osage type of cantaloup that has been grown for several years around Ordway, Colo., adjacent to the Rocky Ford district, is becoming very popular on the market on account of its exceptionally good keeping quality, and its thick, orange-colored flesh that has an exceptionally spicy flavor which many are fond of. But this variety has the weakness of having a very unattractive form and appearance, and a very undesirable tendency to crack open when nearly ripe, thus resulting in a great loss to growers, and in fact on this account this variety has not been a success except in a few localities.

The following table gives the usual time of planting and the period of harvest for the different districts.

District and State.	Dates of Planting.	Period of Ripening.
Brownsville, Texas	Feb. 10 to 20	May 10 to June 10.
Gainesville, Fla	Feb. 10 to 20	May 10 to June.
Imperial Valley, Calif	Feb. 20 to March	May 20 to July 1.
Lake Charles, La	March 1 to 15	June 1 to July 1.
Northern Louisiana	March 20 to April 20	June 20 to July 20.
Blackville, S. C	April 1 to 15	June 15 to July 10.
Belton, Ark	April 1 to 20	July 1 to August 1.
Southern Mississippi	April 1 to 10	July 1 to August 1.
Glendale, Ariz	April 1 to 20	July 5 to August 5.
Atkoa, Okla	April 1 to May	July 10 to September.
Decker, Ind	April 1, in hot beds	July 10 to August 20.
Southwest Arkansas	April 1 to 15	July 1 to August 1.
Moapa, Nev.	April 1 to 15	July 20 to August 10.
Dover, Del.	April 5 to 20	August 1 to 15.
Anna, Ill	April 5 to 15	August 1 to 20.
Knox Co., Tenn	April 20 to May 20	July 20 to September.
Greenriver, Utah	April 20 to May	July 25 to August 25.
Eastern Washington	April 20 to May	August 1 to September.
Medford, Oregon	April 10 to May	August 1 to September.
Parsonsburg, Md	May 1 to 18	July 20 to August 15.
Northwest Arkansas	May 1 to 15	July 20 to August 15.
Rocky Ford, Colo	May 1 to June 1	August 5 to October 1.
St. Thomas, Pa	May 10 to 20	August 25 to September 10.
Fredericksburg, Va	May 10	August 10 to September 1.
King Hill, Idaho	May 10	August 10 to September.
Michigan	May 20	August 20 to September 20.

The above table is tentative.

It will be noted that there is a wide range of differences in the time of ripening when canteloupes are planted at about the same time, due to the different seasons, the climatic conditions, and the soil, and these same differences make different results in the appearance and quality of the canteloupes to quite an extent.

PHILO K. BLINN

CANTELOUPES, GRADE RULES. See under *Apple Packing.*

CANTALOUP DISEASES

Anthracnose

The common anthracnose fungus of the muskmelon (*Colletotrichum lagenarium* Pass.) is the same as that of the cucumber. It attacks the stems of plants of all sizes as well as the leaves, resulting in the lesions of the stem and dead spots in the leaves. In these the fungus produces the fruiting bodies. After the seedling stage is passed it is usually possible to keep the anthracnose in check by the spraying as recommended for cucumbers.

The fruit anthracnose of the muskmelon (*Colletotrichum oligochaetum* Cav.) is widely distributed. It forms yellowish, diseased spots on the fruits and may disfigure them considerable. Thorough spraying with Bordeaux mixture should hold it in check if begun on the young fruits and repeated once or twice at intervals.

Cladosporium

A fungus occasionally parasitic on melons. It produces sunken spots on the fruit and stems, usually during moist weather. Under such circumstances the fruiting stage of the fungus appears over the fruits in an olive green color.

Downy Mildew

Plasmopara sp.

Downy mildew of muskmelon is caused by the same plasmopara fungus as the downy mildew of cucumbers. It does not appear until toward the middle of August, but is then very destructive, sweeping rapidly over the melon fields and leaving only devastation behind. In its attacks the spots of the muskmelon leaves are somewhat different in shape and usually of a darker color than in the case

of the cucumber. One with experience can readily distinguish by the use of an ordinary hand glass. He will then see on the underside of the leaf the violet spores and spore-bearing threads of the mildew fungus. The melons which are unripened upon the vines when attacked by mildew are practically worthless and for this reason large losses are usually incurred. The treatment is by Bordeaux mixture.

Muskmelon Leaf Blight
Alternaria sp.

Is a disease more or less peculiar to the muskmelon, although the fungus which causes it has also been found upon cucumber leaves. The leaf blight causes rather large dead areas in the leaves which are usually distinguished from those of downy mildew by their larger size and the tendency of the central portion to break out. The prevention of muskmelon leaf blight is by no means an easy matter, requiring of itself great thoroughness and carefulness in the application of the Bordeaux mixture and also requiring that the downy mildew shall be watched during the same period. For this reason earlier sprayings, if made before August 1st, should be repeated at fortnightly intervals, while those after August 1st should be at weekly or 10-day intervals. Melon growers have succeeded by following these lines, while others who were less thorough were less successful, or failed entirely. The treatment is recommended with confidence.

Wilt

Muskmelon wilts are the same in general character as those described for the cucumber. Not only the bacterial wilt disease but the wilt due to fusarium has developed upon muskmelons in some parts. The symptoms are the same as for cucumbers, namely: sudden wilting as from lack of water, followed by dying.

Gather and burn infected vines and practice rotation.

Root Rot
Rhizoctonia

The root diseases accompanied by rotting of the rootlets and induced by the sterile fungus of lettuce rosette is also found on greenhouse muskmelons. This is liable to be the case where these follow diseased crops of lettuce. The prevention is thorough soil treatment.

A. D. Selby,
Wooster, Ohio.

For other diseases affecting cucurbitous crops, see *Cucumber*.

CANTALOUP PESTS

Cantaloup Fly
Euxesta notata Wield., Family Ortalidae

General Appearance

The adult flies are slightly over one-eighth of an inch long, beautiful metallic green in color with eyes dark brown. The wings are transparent with a distinct black spot near the middle of the front margin and a similar spot near the tip of each. The maggots vary from white to dusky brown, the blunt end being often darker than the rest of the body. They are about one-fourth of an inch long when fully matured.

Life History

The eggs are laid in the tissues of injured or damaged fruits and vegetables and while the maggots work principally upon such tissue they are often found in sound and living portions and occasionally in apparently uninjured fruits. The pupae are found in the decayed hosts or in the soil, the adults emerging in a very short time. Due to the peculiar habits of the larvae, they have often been mistaken for the maggots of the true fruit flies of the family *Trypetidae* and have been the occasion of great alarm.

E. O. Essig

White-Lined Sphinx
Celerio lineata Fab., Family Sphingidae
Deilephila lineata Fab.

General Appearance

This is a very common insect. The adult moths are quite large, having a wing expanse of nearly three and one-half inches. The fore wings are green with broad brown bands on the front and apical margins and in the middle of each. The veins are white. The hind wings are very small, dark brown with a wide lighter band across the middle of each. The thorax is grayish with distinct white

lines, while the abdomen is dark green marked with black and white spots. The larvae are quite large, often more than three inches long. The color varies considerably, but is usually light green with a row of spots along each side of the back. The spiracles, just above the feet, are margined with black and yellow. A pale yellow line extends down the middle of the back. The chrysalis is dark brown.

Food Plants

The larvae of this species are so common as to be often mistaken for other members of the family. They are usually found feeding upon the foliage of the apple, grape, pear, melon and tomato vines.

E. O. Essig

Melon Aphis. See under *Aphids*.

For other pests of cantaloup and other cucurbitous crops, see *Cucumber*.

Capillarity in Different Types of Soil. See *Soils*.

Carlots, Cities in Which Fruits are Sold in. See *Reduction of Waste in Marketing*, market section.

Cars, How Diverted. See *Reduction of Waste in Marketing*, in market section.

Carlot Markets. See *Reduction of Waste in Marketing*, in market section.

Carob

The carob tree (*Ceratonia siliqua* L.) is a native of the Eastern Mediterranean countries and is widely grown in Italy, especially in the southern part of the peninsula and in Sicily, because of the value of its pods as food for domestic animals. The tree attains a large size, sometimes reaching a height of 50 feet, and in shape is much like a live oak. The heavy dark green foliage, composed of thick, leathery, rounded leaves arranged on each side of a stem, as in the common locust, affords an abundance of excellent shade in hot weather. The tree resists drouth and grows readily on rocky hillsides where it is impossible to irrigate and where the soil is poor and scarce. At the same time, it is appreciative of good rich soil, and grows larger and more symmetrical under favorable conditions. The bark of the carob is rather smooth on the larger limbs, and light gray in color, but on the smaller branches, that is, those which are from three to five years old, there are numbers of roughened knots, giving these branches a diseased appearance. But on examination it will be found that all the pods are borne on these branches, and that the knots are the places where the fruiting stems of the previous year or two were attached. These stems fall off with the pods, and the knots disappear in the course of two or three years.

The fruit of the carob, as I have said, is in the form of pods, very similar in appearance to bean pods, and called by the Germans St. John's bread. In the spring the young pods, hanging in clusters from the branches, look exactly like string beans, being of the same shape and color. Later they become broad like the pods of lima beans and when ripe they are broad and flattened and are two or three inches long and nearly an inch wide. By this time they have become a dark chocolate color and consist of a rather soft shell, nearly filled with a reddish, saccarine flesh, imbedded in which are a number of dark red, flattened seeds. The ripe pods are heavy, and contain about 65 per cent of gum and sugar, making excellent food for sheep and hogs, particularly when it is desired to fatten these animals. They are also fed to cattle and horses at the rate of about six pounds a day, the pods being crushed and fed either raw or boiled. The seeds germinate readily if fertile, but there must be a number of trees growing near each other and bees must be plentiful to insure fertility. In Southern Italy and particularly in Sicily, the pods are used as food by the people, and the children among the lower classes eat them as they would candy. The ripe pods are either boiled or roasted, and are sold on the streets everywhere, where one may buy a dozen or more for a cent. They have a sweetish, slightly bitter taste, and are somewhat astringent. In the cooked state they are undoubtedly healthful and very nourishing.

The carob tree is one of the necessities, almost, of the average Italian farmer. It gives him and his stock ample protection against the hot summer sun; its pods are food for the animals, and for himself as well, if necessary; and it does not demand rich soil. It is most frequently planted where little else will grow, in rocky land or about the edges of gardens or olive groves, and with its sturdy form and thick, heavy leaves it withstands perfectly the hot dry Sicilian summers.

E. J. NEWCOMBER,
In the California Cultivator.

Carrots

The carrot grows wild in the fields and on the roadsides of Great Britain and the seashores of the North Temperate zone of the Old World. It resembles the cultivated carrot, except in the root, which is thin and woody. However this wild carrot is the parent of the cultivated varieties.

Carrots vary considerably in the length, shape and color of their roots, and in the proportion of rind to core. The White Belgian, which gives the largest crops, has a very thick root which is white, becoming pale green above, where it projects above the ground. For nutritive purposes, it is inferior to the red varieties. The carrot succeeds best on a light sandy soil, which should be well drained and deeply trenched. If not naturally fertile the ground should be well prepared and heavily manured, in the autumn or winter. For the long-rooted sorts, the soil should be at least three feet deep; but for the shorter rooted varieties a soil of less depth is sufficient.

Growing Carrots

For the early crop sow the seed as early in spring as the ground can be worked in rows 10 to 12 inches apart if hand cultivated, and 18 to 24 inches if cultivated with a horse. About two pounds of seed are required per acre. Cover the seed about one inch deep. It is advisable to mix in a few radish seed to help locate the rows, since the carrot seed germinates slowly, and cultivation to keep down weeds is frequently necessary before the young carrots make their appearance. When the plants are well up they should be thinned to stand two to three inches apart in the row. Frequent shallow cultivation should be given with some light implement throughout the season. Late varieties for stock may be sown the latter part of May or as late as the middle of June in the Northern states. The plant makes its best growth in the cool weather of fall.

The crop is harvested usually by hand pulling and topping. The work of pulling is often facilitated by running a plow alongside the rows to loosen them. Where the half-long varieties are grown they can frequently be plowed out. From 200 to 300 bushels per acre is a good yield. The roots may be stored in pits or in the cellar like potatoes. There is a considerable amount of hand labor in the culture of carrots, which makes their growth relatively expensive.

Besides the use of carrots as a table vegetable they form a favorite succulent food for horses and dairy cows. Foreign experiments show that for stock feeding purposes carrots are about equal to other roots. The agricultural experiment stations in this country have reported but few experiments with this crop as a stock food. Except for the purpose of variety in the diet it will probably be economy to grow other larger yielding root crops, like mangels and rutabagas.

GRANVILLE LOWTHER

CARROTS IN ALASKA. See *Alaska*.

CARROT DISEASES

Leaf Spot

(*Cercospora Apii* Fres.)

Same fungus as causes celery leaf spot. See under *Celery Diseases*.

Root Rot or Rhizoctoria

Corticium vagum B. & C. Var. *Solani* Burt.

Same as potato root rot, which see.

Soft Rot

Bacillus carotovorous Jones

One of the commonest bacilli parasitic upon plants. It produces a soft rot on

many vegetables. Avoid planting infected seed and planting in infected soil.

CARROT PESTS

Carrot Beetle

Ligyrus gibbosus, Dej.

Common along the Atlantic coast and occurs as far west as Illinois. Called also the sunflower beetle on account of its attack on this plant. It is injurious to parsnip, celery and sweet potato.

The beetle is one-half to five-eighths of an inch long and robust.

Rotate the crops, permit the chickens to follow after the plow in the fall and in case of severe infestations, turn the hogs into the field.

Literature

Division Entomological Bulletin No. 33, New Series.

Carrot Rust Fly

Psila rosae Fab.

Imported into Canada, whence it has spread into New York. A very minute fly measuring about one-sixteenth of an inch. Produces a reddish appearance on the leaves of the young plants and rusty blotches on the roots. The stored roots are sometimes infested with the larvae.

Rotation of crops is advised, but the same fly attacks celery, hence this plant should be excluded from the rotation.

Spray with kerosene emulsion one part to 10 of water, or sprinkle sand, ashes or land plaster mixed in the kerosene along the rows. Make these applications once a week through June.

Literature

Division Entomological Bulletin No. 33, New Series.

CELERY CATERPILLAR. See under *Celery*.

PARSNIP LOUSE. See under *Parsnip*

CATCH CROPS. See *Apple Orchard Cover Crops*.

Cauliflower

The cauliflower belongs to the cabbage family and was introduced into Europe from Cyprus and the Mediterranean coast. It is one of the most delicately flavored of vegetables and is much more delicate in its growth than the cabbage. It is less resistant to heat and cold, and requires more care than the cabbage; but under proper conditions, is one of the most valuable of vegetables, bringing a good price in the markets. It forms a dense cluster of incipient flower buds which are the edible portion of the plant. It succeeds best in a rich soil and sheltered position. It is propagated like the cabbage and given similar care; except that when the head begins to form, the large outside leaves should be pulled over it and fastened together at the top in order to prevent injury from the hot sunshine.

As a crop, they ripen somewhat irregularly and, as the period of frost approaches the immature heads should be pulled with roots and leaves and be planted in a cold cellar or cold frame where many of them will form salable heads.

There are many varieties; but perhaps the most desirable are the Snowball and Early Dwarf Erfurt.

The insect enemies are the same as those of the cabbage.

Being of the same nature as the cabbage, and requiring similar treatment, we refer our readers to the article under that heading.

GRANVILLE LOWTHER

CAULIFLOWER DISEASES

For the most part cauliflower is affected by the same characteristic diseases as cabbage. They will be found treated under cabbage.

Ricing

This is not a disease but is a trouble caused by the starting into growth of the flower heads, usually after a rain following a dry spell. It injures the appearance but not the quality of the head.

The trouble is corrected by cultivation so as to preserve a good dust mulch during dry periods.

Soft Rot or Stump Rot

Bacillus carotovorous Jones

A common soft rot of vegetables and a most serious one to cauliflower, appearing at its worst in seasons of hot, damp weather. The bacillus is a wound parasite but the manner of its spread is un-

known. It spreads very rapidly at times. The center of the stem and head usually rot first so that the plant may be beyond recovery before the presence of the disease is detected. The odor arising from the decaying heads is very repulsive.

Rotation seems to be the only remedy.

Literature

Cornell Bulletin No. 292.

CAULIFLOWER PESTS

The pests of cauliflower are common to the cabbage and will be found treated under cabbage.

CAULIFLOWER, HOW GROWN IN ALASKA. See *Alaska*.

Celery

More and more celery is growing into favor as a garden vegetable It grew wild in England, beside the ditches, in marshy places, in swamps, especially near the sea, producing a furrowed stalk, with compound leaves and wedge-shaped leaflets. In its native state, the plant has a coarse, rank taste and peculiar smell.

By cultivation and blanching the stalks lose their acrid qualities and assume a mild, sweet, aromatic taste peculiar to celery as a salad plant.

Propagation

Celery is grown from seed, sown either in a hotbed or in the open garden, according to the season of the year, and after one or two thinnings out and transplantings they are, on attaining the height of six or eight inches, planted out in deep trenches convenient for blanching. The blanching process is one of the most important in the production of celery, and consists in "earthing up," or drawing the earth around the plant to exclude the light.

Soils Best Adapted

Celery is a native of the swamps, generally adjacent to the sea. Since the draining of the swamp lands near the Great Lakes, large areas of those sections are adapted to the growing of celery. In this industry perhaps Michigan takes the lead. However, in the arid regions, where irrigation is practiced, celery can be grown anywhere and the soils too wet for most other crops, and too strong in alkali, may be used for the growing of celery, and in this manner the "seepage lands" utilized for a very profitable crop. Celery has been successfully grown on lands that in the winter were white with alkali.

GRANVILLE LOWTHER

FOR CULTURE IN ALASKA, see *Alaska*.

Growing Celery in an Irrigated Section

*J. L. Reid, Colorado Experiment Station, writes as follows:

Varieties

In commercial growing only two varieties are being used at the present time to any great extent. These are the Golden Self-blanching for the early market, and Giant Pascal for the late market. These supply all that the present market requires, for by proper methods, Golden Self-blanching can be put on the market from early August until the Giant Pascal is ready and this latter can be held as long as it is profitable to keep it in storage. The Golden Self-blanching is not as crisp and tender nor of as good quality as the Giant Pascal, but owing to its earliness, the ease with which it is blanched and the fact that so much more can be grown to an acre, it is far the more important in respect to the amount grown. Pascal celery does not come onto the market until about the first of November and we are entirely dependent on the self-blanching up to that time.

Seed

Most of the seed is procured from American dealers, but the growers nearly always ask for French grown seed, because in that country the seed is usually more carefully selected. A few growers have sometimes grown their own seed and obtained excellent results by its use. Sometimes a grower will raise enough seed one year to last him several seasons, preferring to do this rather than use seed bought from unknown sources. Owing to failures as the result of poor seed, the use of home grown seed would be more than justified, even though it cost more.

* Bulletin 144, Colorado Experiment Station

Vitality of seed is quite variable, so it is impossible to figure the number of plants which may be procured from a given amount. It is estimated in buying seed that one can count on 2,500 plants per ounce of seed, but this is very conservative, for some growers get as high as 25,000 stocky plants per ounce when they have good seed. The number of plants suitable for planting depends upon the vitality of the seed and the care of the grower. It is the practice to sow enough seed to secure more plants than will be needed and then select the best of these. Very often a surplus stock can be sold at a good profit, and it is also advisable to have extra plants for resetting in case of damage to young plants by drought or hailstorm.

Raising the Plants

Celery seed is very slow in germinating and sometimes great difficulty is experienced in getting a good stand of plants. Here is where the gardener must ever be on the alert. The seed bed and young plants must never be allowed to become dried out, and yet water must not be allowed to stand on the surface. The young plants are very tender, and a fine spray should be used in watering them. The seed is sown broadcast in the beds or sometimes in very shallow drills four or six inches apart. The seed should be covered very lightly, if at all. Germination will take place in about three weeks.

The Golden Self-blanching celery is usually sown between March 1st and 15th in mild hotbeds from which have been taken one or two crops of radishes or lettuce. These beds are made with about one foot of manure, over which is spread between six and 12 inches of soil, and the whole is covered with glass sash. By the time one or two crops of lettuce have been taken from a bed, the manure does not give a strong heat, but just enough to protect on frosty nights. If one desires this celery for the August market, it is quite necessary that some artificial heat of this sort be given the seed bed, but fresh beds should be used only with great care or the plants will not be strong. For later sowing of the seeds, frames simply covered with sash may be used.

The Pascal celery is mostly sown between April 1st and 15th in frames under cloth, although a great deal is sown in the open ground. The advantages of growing under cloth are that the soil is kept from dying out and the young plants are protected from extremes of temperature. It is not considered profitable to transplant celery, so it is left in the original beds until ready for setting in the field, although much more stocky plants may be secured by giving an extra shift.

When the plants are grown in hotbeds, as many as 8,000 are sometimes raised under a three by six foot sash. However, when less expensive beds are used, it is better to use more room, as one thus gets far stockier plants. Many growers sow one-fourth ounce of seed to one sash three by six feet, but this crowds the plants somewhat. It is very important that the plants be carefully "hardened off." This is done by gradually getting them accustomed to the wind and sun. The sash is raised more and more each pleasant day until the plants can stand to be entirely uncovered. It is very important that they should never be allowed to become cold enough to be frosted as this no doubt is one of the principal causes of going to seed.

Several methods are in use for making the plants stocky. Transplanting has already been mentioned, but this is an expensive process. Clipping the tops off lightly once or twice while in the beds is practiced to quite an extent. A few growers have a knife so mounted on wheels that it can be run under the plants, so as to cut off the tap root, thus causing more side roots to develop.

Setting of Plants in the Field

When the ground has been thoroughly prepared and danger of frost is over, the plants may be set in the field. If an early crop is desired it is, of course, necessary that the plants be set early, so as to give them as much time as possible to get their full growth. If the plants are crowded in the seed bed, it is a good

practice to thin them and use the plants removed for the first setting. This gives the remaining plants a better chance.

A small furrow is made and the irrigating water is turned into it. This settles the soil and puts it in good condition for setting the plants. After the water has seeped out of the ditch it is the plan of most growers to run a small stream into the furrow again. The surface of the water this second time leaves a line along the edge of the furrow and the plants are set along this line, thus making them all at the same level. In this way none of the young plants are covered when irrigated, and yet all are close to the water. Where self-blanching is grown, a row is set on each side of the furrow, making two rows about 12 inches apart. Where Giant Pascal is raised, plants are set only on one side of the furrow, and that on the south side if the furrows run east and west, so that the plants may escape the reflection of the sun's rays from the water. The furrows are made about four feet apart. The plants are set from six to eight inches apart in the row. With single rows four feet apart, plants eight inches apart in the row, 16,710 plants would be required per acre; with plants six inches apart in the row, 21,780 plants would be used per acre. When self-blanching is grown in double rows, just double this number of plants would be used. It is well to have an abundance of plants so that later on any vacant places may be filled.

The beds are watered very thoroughly before removing the plants for setting, and then the plants may be pulled out singly by the roots if it is desired to thin the beds somewhat. The plants are arranged in bunches which can be held conveniently in the left hand. They are put in a box over which is thrown a wet sack to protect from the sun while being carried to the field. In setting, some simply lay a plant on the first finger of the right hand and stick it into the mud on the side of the furrow; others, where the soil is heavier, make a hole in the soil with a pointed dibble held in the right hand and place a plant in the hole with the left, the dibble then being stuck into the soil beside the plant to close the hole. It is a good plan to wet the roots with puddled mud just before starting to set a handful. There is quite a knack and a whole lot of hard work in setting, but it can be learned much more quickly by watching a good workman and by doing it oneself than by reading how to do it.

Cultivation

Since celery is transplanted to fields which are clean of weeds, the plants have the start of the weeds. However, it is generally necessary to give one or two hand weedings. A wheel hoe is used once or twice, and four or more cultivations are given with the horse and a harrow-tooth cultivator in the wide spaces. Some make a practice of cultivating once a week during the growing season. Those who blanch with dirt often use a five-tooth cultivator the last time or two, so setting the teeth as to throw some dirt toward the rows.

Irrigation

Concerning irrigation, each grower has his own ideas as the result of his experience under his particular conditions. Some do not irrigate more than two or three times during the season. Others irrigate nearly every week, commencing at the time of setting. On sandy, well-drained soils it is necessary to irrigate very often. One must use his own judgment, always remembering that celery grows in swamps in its natural condition and, therefore, cannot stand drought.

During the growing season the water is run in the furrows which were made at the time of setting the plants. If double rows are used, as soon as the crop has a good start this furrow will be completely hid by the tops of the plants, but the water will still follow the ditches in good shape if they have been kept clean of weeds. Since the ditch at this time is shaded by the plants, the soil dries out less rapidly and does not bake so badly.

Blanching

Blanching consists in so excluding the light that tender stalks free from color-

ing matter may be obtained. Self-blanching varieties for the early market are blanched entirely with boards. The banking of celery high with earth during the hot summer days sometimes hurts the crop. Blanching with boards keeps the celery cleaner, but is quite expensive, owing to the great cost of lumber, so it is generally practiced only for a part of the early crop. Boards 12 to 14 inches wide by any convenient length, usually 16 feet, are used. It takes about 20,000 feet of lumber to blanch an acre at one time, but since during the warm part of the year the blanching will be completed in about three weeks, the boards may be used to blanch a second lot. If the boards are carefully piled each year so they will not warp and are protected from the weather in some way, they will last many years. Some use wire hooks to hold the boards together instead of using stakes.

By far the largest part of the crop each year is blanched by means of earth. One horse is used on a celery hiller, which runs between the rows and throws the dirt against the plants. It is generally necessary to run this machine through twice in order to do a good job, and sometimes two horses must be used tandem to pull the hiller. Some growers like to finish the earthing with shovels or hand tools, but this adds to the expense. The celery hiller has iron rods so fixed as to lift the leaves out of the way so they will not become covered with earth. About four weeks are necessary for blanching with earth in the field.

For later use a great deal of celery is left to grow in the field as long as there is no danger of frost, and then removed to trenches for blanching. Giant Pascal is either blanched in this way or is partly blanched in the field by means of "papering," and then removed to the trenches. A great deal of self-blanching is also blanched in trenches. The celery is removed from the row, without trimming the roots too closely, and put into long, narrow trenches, so that about two-thirds of the plant will be below the level of the ground. From 12 to 18 inches is as wide as the trenches should be made, for, if too large quantities are stored together, there is danger of loss from heating. The tops of the plants are covered with light material only as there is danger of freezing. When extreme cold weather comes, earth must be used for protection. Careful watch must be kept to see that the celery does not spoil from being covered too deeply, and yet, if it is allowed to become frozen to any great extent, it will be unsalable. As soon as the plants are set in the trench, water is turned in and a thorough irrigation is given. This will usually furnish enough moisture for the crop until it is ready for the market. If, as is often the case with Giant Pascal, the celery is not dug until late and is to be kept far into the winter, a second or a third irrigation may be necessary in dry seasons.

There is a limited market for "papered" Giant Pascal celery. By this is meant the wrapping of each plant in paper during the latter part of the growing season. This work is commenced in August, and boys are usually hired to do it at two and one-half cents per dozen plants wrapped. Old daily papers are used, and one string holds the paper in place. It is important that this work be postponed until the celery is high enough so that the tops of the leaves will be above the paper after wrapping. Old papers can be bought for $8 or $10 per ton. As soon as there is danger of frost the celery is dug, put in trenches, and handled in the same way as the other; but has however the advantage of being cleaner and is already partly blanched.

Storing

Since the California and Florida crops get onto the market during the winter and spring, it has not been found profitable in northern sections to store celery for any great length of time.

Harvesting and Marketing

Where only a small area is devoted to celery, the plants are usually loosened from the ground by means of a spade. The roots are cut off and the plant is laid to one side. Where the acreage is

larger, especially where soil is used entirely for blanching, a celery digger is used. Different styles of home-made machines are being used for this purpose, but the principle of them all is to run an edged tool just under the plant, thus cutting off the root so it can be taken up by hand.

Golden Self-blanching celery is usually "shipped in the rough." A few of the outside leaves are removed and the celery is packed directly into crates. The number of dozen plants in the crate is marked on the outside, the side of the crate is nailed, and the crate is ready for the car. These crates are usually 20x22 inches by 24 inches deep. The top is entirely open, except for a strip along each edge. When celery is to be packed for "shipment in the rough," one of the other sides is left open so that the plants may be packed in from the side. The remaining side is then nailed on and the celery is thus held securely in place. A crate will hold from four to seven dozen of celery, according to its size at the time of marketing.

Celery Growing in a Humid Section

*C. P. Halligan, of the Michigan Experiment Station, makes the following suggestions on celery culture for that section:

The distance to plant celery depends much upon the variety, season, methods of blanching and intensiveness practiced. Where celery is to be blanched by boards, the rows may be set from 18 inches to three feet apart while celery which is to be blanched with soil is commonly set from four to six feet apart. At Kalamazoo and Muskegon, where early celery is grown, the first planting is set in rows about three feet apart and the second crop is planted later between these rows. Sometimes only every alternate row is thus interplanted at first but a late crop is afterward set in the vacant places. This will leave a space of six feet for blanching the last crop with soil. When a summer crop is grown alone and the celery is to be blanched with boards, the rows are set from 18 inches to two feet apart. In other sections, where land is less valuable and the culture less intensive, the rows are planted from three to four feet apart thus permitting horse cultivation. In outlying sections, where larger areas are handled, the cost of production will be less if planted at about this distance.

* Bulletin 60, Michigan Experiment Station.

The distance the plants are set in the row is also more or less variable but three plants to a foot is the general rule in this state. Giant Pascal and other large growing varieties are usually set six inches apart while some growers even prefer a space of eight inches for this variety.

Table of Plants Required per Acre

Distance between rows	Distance between plants	Number of plants	Lumber required for blanching
18 inches	4 inches	87,000	58,000 sq ft.
2 feet	4 inches	65,240	43,500 sq. ft.
3 feet	4 inches	43,560	29,000 sp. ft.
4 feet	4 inches	32,670	21,750 sq. ft.
5 feet	4 inches	26,136	Earth
5 feet	6 inches	17,424	Earth
6 feet	6 inches	14,510	Earth
6 feet	8 inches	10,881	Earth

One ounce of seed should produce at least 10,000 plants.

Cultivation

Celery must be kept continuously growing if stalks of high quality are desired. Although an excessive feeder, demanding plenty of plant food and moisture, the plant has a very shallow root system. Therefore, constant but shallow cultivation is absolutely required to produce good crops. As soon as the plants are set in the fields, the rows should be cultivated, being especially careful not to throw any soil over the hearts of the plants. Hand hoeing may be necessary between the plants. Cultivation must be then given after every rain and as often otherwise as it is necessary to maintain a fine dust mulch over the soil. This will prevent the moisture of the soil from passing off into the air and in addition to keeping the roots well supplied with water, it will prevent the roots from working deeper into the soil where the supply of air is not so plentiful and the production of plant food not so rapid. Constant cultivation induces a larger and better quality of growth by preserving

the soil moisture and keeping the roots near the surface where the plant food is liberated more rapidly.

As the surface of the soil in cultivating should not be thrown up in ridges but kept as smooth and fine as possible, a small-toothed cultivator should be used in preference to the larger shovel tooth types.

About the Kalamazoo section, the crop is planted in rows too close to permit horse cultivation and the fields are worked with hand cultivators. These are especially desirable for cultivating the crop as they permit stirring the soil very close to the plant without danger of injury by deep cultivation.

Marketing

The marketing of the celery crop starts in this state about the first of July and continues more or less steadily until mid-winter. The harvesting season of the various celery districts in Michigan come at such times that one district does not enter into serious competition with another in the general markets. The Kalamazoo, Muskegon and Grand Haven districts, for example, grow early celery, starting their marketing about the first of July and continue until some time in October. Even these sections hardly compete with each other, as the Grand Haven and Muskegon crops are shipped across the lake to Chicago, or Milwaukee, while the Kalamazoo crop is sold largely in other cities, being expressed to points all over the United States. During the fall, the other districts, at Decatur, Vriesland, Hudsonville and other smaller sections where the crop is grown more extensively, begin shipping and aim to dispose of most of their crop before severe freezing weather. A small portion of this crop in these districts is trenched in the field, but is generally disposed of before mid-winter when the California product enters the market.

Harvesting

Celery may be harvested as soon as it attains the proper size and is well blanched. With the earliest crop, to gain the advantages of a high market, it is frequently cut slightly before this time and it often pays better under these circumstances than to wait for the crop to fully blanch and mature. If the plants are left too long after they have matured, they lose their crispness and flavor and are apt to become diseased.

When the crop is harvested during the summer months and is to be shipped long distances, the plants should be cut and carried to the packing shed early in the morning. In the Kalamazoo district, this work is all performed before 7 o'clock in the morning. The boards used for blanching are removed only as fast as necessary and laid between the rows to serve as a walk. If the plants are left exposed to the sun and wind, they lose their firmness and are apt to wilt, hence the boards are removed only as fast as the celery is cut. Using a stiff knife or spading shovel, the roots are cut a short distance below the surface of the soil and the plants laid in small piles along the boards. As the packing shed is generally nearby, wheelbarrows are used to gather the plants as fast as they are cut, and they are carried at once to the packing house. Where this building is more distant or the operations more extensive, wagons are used and the plants covered with canvas on the way to the packing house.

After reaching the packing house, the plants are trimmed by removing the outer leaves and cutting the roots to a more or less conical shape with a flat point near the base of the plant. They are then thoroughly washed in clean cold water which helps to keep them in a firm, fresh condition. After being allowed to thoroughly drain for some time, they are tied into round bunches containing 12 good sized plants. In early July, when the plants are rather small, 13 or 14 of them are sometimes necessary to make a good sized bunch.

Generally the only grading practiced by the growers consists in discarding the smallest plants or "culls" and bunching all the marketable sized plants together. Some growers practice more rigid grading, selecting the largest and best plants, bunching separately and shipping these

to a special market. The smallest plants are sold locally and seldom pay to pack and ship.

In bunching celery, a board about a foot long and eight to 10 inches wide is nailed along the upper edge of the packing bench, with a semi-circular piece cut out along the upper side of it large enough to hold the bases of 12 good sized plants which, when placed in it can be quickly tied into a round bunch. Extra stout white string is used, making one tie around the base of the plants and one near the tops.

Many of the more careful packers of summer shipments are now wrapping each bunch separately, with heavy brown paper, using open crates. This tends to prevent the heating of the celery in long shipments during hot weather and will undoubtedly be used more as its advantages become appreciated. However, most of shipments are made in tight crates which are lined with heavy wrapping paper. The size of the several crates used varies considerably throughout the state but the following is a list of the common sizes used at Kalamazoo:

Sizes of Kalamazoo Celery Crates

Inches	Inches
6x 8x24	6x24x24
6x10x24	6x26x24
6x12x24	6x28x24
6x16x24	10x16x24
6x18x24	10x18x24
6x20x24	10x20x24
6x22x24	10x24x24
10x26x24	

In the other celery districts of the state the crates are quite different in form and the celery frequently packed loose in the crates. The following are the sizes genrally used:

Inches	Inches
6x12x20	10x10x18
6x12x22	10x10x20
6x18x22	10x10x22

At Decatur much of the crop is shipped in the rough. When shipped in this manner some of the roots are left on the plants and only a few of the outside leaves removed. The celery is then packed in large open crates, being trimmed and bunched in the storage houses of the cities by the commission dealers before being delivered to the retailers. Shipping in this manner enables the growers to handle and ship their crop while the weather is favorable and the crop is placed in a fresh, crisp condition upon the market

Storing

Although most of the celery in Michigan is sold before freezing weather, about Hudsonville, Vriesland and some other sections, large quantities of it are stored for early winter. Many market gardeners about the cities of the state dealing with a special or local market also store this crop.

When the crop is to be sold in late fall it may be simply banked as high as possible with soil and the tops covered with straw, to protect the plants from light freezes. Celery that is to be stored for early winter is usually trenched. This consists of digging a trench about a foot deep in the field between the celery rows, into which the plants are closely set, so that the tops are not more than two inches above the ground. The trench may be dug by hand or by plowing out a double furrow, and the plants should be lifted from the rows while the foliage is dry, with some soil clinging to the roots. A protection of some sort must then be provided. When blanching boards are at hand they may be nailed together in a V form and placed over the trenches. If the weather then turns warm after trenching, they may be slightly raised with blocks or stones, for ventilation. As it gets colder a light furrow of soil may be turned against the base of the boards, and later, the boards covered with manure to protect the plants. If boards are not available the plants may be covered with hay or straw, until danger of severe freezing, when they may be further protected with manure.

The storing of celery in this state for late winter is generally unprofitable, and hence it will seldom pay to erect a celery storehouse for this purpose. Storage pits, vacant hot beds or cellars are often satisfactory for storing this crop. In fact, it may be stored in any place where the plants may be kept cool and moist, without danger of freezing and where thorough ventilation may be given, especially during warm weather.

Diseases

Celery as grown in Michigan is not as susceptible to injury of fungus diseases as in many other sections of the country. The comparatively cool, moist days of the growing season are especially favorable for the production of healthy, vigorous plants, but in seasons that are unusually warm, these diseases often become very injurious and sometimes ruin entire crops.

Damping-Off

Rhizoctonia

This is the most serious disease of the celery plants while in the seed bed. During the first two weeks after the seedlings appear, it is especially apt to attack the plants. This disease causes a decay on the main stem or root just at the surface of the soil, which quickly kills the young seedling. During warm moist weather it is apt to be very injurious, spreading rapidly throughout the bed. In the greenhouse, too much heat, lack of ventilation, and watering the plants on dark cloudy days, or late in the afternoon, all tend to promote this disease. Thorough ventilation, plenty of light, judicious care in watering, in general, keeping the plants on the "dry side," tend to prevent this disease.

Early Celery Blight

Cercospora apii

A common disease of celery infecting the foliage early in the season. It first appears as well defined spots on the leaves that soon become so numerous as to cause the leaves to turn yellow and finally die. On the dead leaves the disease multiplies very rapidly and soon spreads to the other plants. It does not generally appear late in the season, but plants weakened by this disease are often afterwards attacked by the late blight. Spraying the plants with Bordeaux mixture, as recommended for the late blight will control this disease, the early spraying being especially important.

Late Celery Blight

Septoria petroselini

Of the diseases affecting celery this is generally the most common and serious one. It first appears in late summer or early fall as irregular rusty brown spots on the outside leaves, spreading under favorable conditions over the entire leaf surface and to other leaves of the plants, causing a burned appearance to the foliage in a very short while. During unusually warm, moist weather in the growing season, or after the crop is stored, this disease proves very destructive. Plants set upon poorly drained land or plants stunted or weakened by any other means are especially susceptible to it. If the plants are kept growing vigorously and well cultivated they are not as susceptible to it, and are generally able to withstand its effects. However, when the blight has become well established upon the plants it is then too late to apply effective remedial measures. The disease may be prevented also by spraying the plants with Bordeaux mixture,* using the 5-5-50 formula, or the ammoniacal carbonate of copper spray, beginning when the plants are small, spraying once before lifting them from the seed beds, and continuing the spraying every ten days or two weeks until the plants are ready to blanch by boards. The success of this work will depend largely upon the thoroughness with which the foliage of the plants is covered, as it is important that all portions of the plant be reached by this spray. All diseased plants and refuse left in the field after harvesting should be carried from the land, rather than to turn it under with its spores of this disease to cause another infection the following season. When conditions will permit, rotation of crops will prove very desirable, devoting the land to cabbages, onions, peppermint or some other suitable crop for two or more years until the land is free of these spores.

Insects Affecting the Celery Plant*

The celery plant is by no means immune to insect attack. It is preyed on by many of the garden pests, army worms, cut worms, the zebra caterpillar, the celery looper and by a number of other caterpillars. Besides these are several sucking insects, plant lice, leaf hoppers, a

* For details of spraying send to Michigan Experiment Station for bulletin on spraying.

negro-bug and a thrips. Most conspicuous of all is the parsley caterpillar, which works also on carrots, caroway, fennel and other plants of the same family—a naked caterpillar nearly two inches long, green or yellow in color, with transverse black bands, and spotted with yellow. When disturbed, the larva protrudes a Y-shaped yellow horn, from which emanates a sickening odor, presumably distasteful to birds and other enemies. The adult is the common black, parsley swallow-tail butterfly, a beautiful velvet black butterfly having long swallow-tails, and marked by rows of yellow spots.

Control of these insects will depend on their feeding habits. Grasshoppers should be killed by Criddle mixture, which is poisoned and slightly salted horse manure. Flea beetles may be driven away or killed by arsenate of lead, while the plants are small, that being the time when most injury is done. Cut worms like poisoned bran, made by mixing thoroughly, one pound of Paris green with fifty pounds of dry bran and then moistening it with a little molasses and water. The zebra caterpillar can be usually hand-picked profitably, as well as the parsley caterpillar. The plant lice and negro bugs should respond to a spraying with *strong* tobacco tea or with one of the nicotine extracts. This is true also of the thrips.

The leaf hoppers will be driven away by such a spray, but they will return after it evaporates. For the latter, a regular practice of clean culture, and the burning of all rubbish, after cold weather has set in, will gradually get rid of them, especially if this treatment be extended over a wide area. Many noxious insects winter in rubbish, fallen leaves, along hedges, etc.

R. H. Pettit,
Entomologist of Mich. Exp. Sta.

CELERY DISEASES

Bad Seed

There is scarcely a more vital question in celery growing than that of the quality of seed used. Seed that is of a bad strain though true to varietal name, may inflict losses of hundreds or thousands of dollars on large growers. Hollow celery, or that otherwise useless, according to present knowledge is very often due to the bad seed.

Black Root

Found on plants in seed beds.

Damping Off

This trouble is caused by a fungus which follows careless watering while the plants are very small, attacks the seedlings at the point where they emerge from the soil, causing them to decay at this point. This disease may be avoided by starting the plants in trays, and subwatering them by setting the trays in a shallow trough containing about 1 inch of water, allowing the water to enter through the drainage holes in the bottom of the tray. In this way the surface of the soil will remain slightly dry, while the roots of the plants receive plenty of moisture. Where it is impracticable to apply subwatering methods it will be necessary to water very carefully and to avoid extremes of drought and moisture. It is best to prevent too rapid evaporation by partial shading with lath screens.

Early Leaf Blight

Cercospora apii

Plants may develop this disease in the seed bed, and it is most prevalent in early summer.

Control

Keep young plants coated with 4-4-50 Bordeaux mixture, later using the non-staining ammoniacal copper carbonate solution. Well-drained, half-shaded fields seem to suffer less than others.

Heart Rot

Heart rot is a very destructive decay of the inner, or heart, portions of the celery plant after blanching has begun. The inner parts rot very suddenly, emit a penetrating odor and the market value of the affected celery is destroyed.

The decayed parts are teeming with motile bacteria to which this form of decay has been attributed. The heart rot prevails too in very hot, steamy weather, but preventive measures are about all

that can be recommended. It is suggested that when the boards are first put up to the celery, under such conditions as accompany the heart rot, they should be left apart at the top and only closed up to the usual point after an interval of several days. This secures better ventilation and often prevents the disease.

A. D. Selby,
Wooster, Ohio

Hollow Celery. See *Bad Seed*, this section.

Late Blight

Septoria petroselini var. apii

F. D. Bailey

The disease commonly known as late blight of celery seems to be the most serious disease of that crop in Oregon. It is commonly found in most parts of this country where celery is grown. It also occurs in Europe, and by many is believed to have been introduced into this country, probably through seed. There is a possibility, however, that a similar disease is present on some native weed of the celery family and has spread to the cultivated varieties of celery.

This disease occurs in the plants in the form of spots on the blade of the leaf, though the disease may attack the leaf bases. The spots are small, irregular in outline, and tawny in color (Fig. 1). These spots are caused by a fungus known as *Septoria petroselini*, var *apii*. If examined with a hand lens, numerous small black specks which are slightly raised may be seen scattered irregularly in the spots. These spots contain the reproductive bodies or spores of the fungus. These spores escape through a minute opening and, being scattered by wind and rain, cause the growth of new spots. The spots may appear on the first leaves of the seedlings in the seed bed, a fact which suggests the possibility that the disease may be carried through the seed.

When the fungus is abundant on the leaves, and especially on the leaf bases, there is a tendency to make the stalks brittle, so that minute transverse cracks are formed which reduce the market value.

Usually the spots are clearly defined, but under favorable conditions for the development of the fungus, the entire leaflet may be affected, resulting in a complete wilting of the leaves.

The disease may also develop seriously in storage, particularly if the storage houses are too warm or are poorly ventilated.

It is probable that the disease lives over winter in the dead leaves that are left in the fields at digging time.

Fig. 1. Leaf Spot or Late Blight of Celery.

Remedy

It is advisable, so far as practical, not to trim the plants in the field. Diseased plants and leaves should not be thrown in the compost heap if the compost is to be used as fertilizer for celery beds or fields. It is also advisable, where possible, to practice a three or four year rotation of crops.

Spraying must be practiced as a preventive. The seedlings should be sprayed frequently (at least once a week), beginning when they show the first leaves. The plants should be sprayed in the field often enough to cover new foliage, and especially after every heavy rain. Bordeaux mixture should be used in the 4-4-50 formula. Ammoniacal copper carbonate may be used for the later sprays

in the field, as this mixture does not leave a deposit on the plants.

The practice of overhead sprinkling, as followed by many growers, is especially undesirable as this has the same effect as frequent rains and offers ideal conditions for the development and spread of the fungus. Where irrigation is necessary, arrangements should be made to apply the water in rills.

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Root Rot

Rhizoctonia

Attacks plants during damp seasons. The roots rot off in some cases.

Rust, True and False

In Europe the celery plant is attacked by one or two rust fungi *(Puccinia bullata* [Pers.] and *P. Castagnei* Thum) of the same class of parasitic fungi as those producing rust in wheat. These two rusts have not as yet been discovered in America, though they will doubtless in time become introduced. Celery which is banked in the earth often has the blanched stems marked by rusty spots of various sizes. These spots appear to arise from the contact of the stems with the earth, and on microscopic examination seem to be due to the fungi or bacteria, or both, that may be present in the soil. The difficulty is prevented by avoiding this method of blanching and substituting boards or close culture planting.

A. D. Selby,
Wooster, Ohio

CELERY PESTS

Apple Leaf Hopper. See under *Apple Pests*.

Cabbage Root Maggot. Sometimes attacks celery. See under *Cabbage Pests*.

Celery Leaf Tyer

Phlyctaenia rubigalis

This insect often becomes very troublesome, not only because it destroys the leaves by eating them, but by spinning a web and tying the leaves together. The insect is thoroughly distributed and may at any time become a troublesome pest in any celery field. As a means of controlling this insect, hand picking will be effectual on a small scale. Spray with Paris green in cases where the larvae have become very numerous. Applied so as to reach the underside of the leaves, where the insects feed. It would not be advisable to spray with a poisonous solution late in the season after the edible portion of the celery has begun to form.

Celery Looper

Plusia simplex Guen.

* In some portions of our country, as, for example, in Illinois, this species to a certain extent takes the place of the cabbage looper *(Plusia brassicae* Riley). It is stated to be the commonest species of its genus in Illinois, and is rather generally distributed in the United States east of the Rocky mountains, from Canada to New Mexico.

Descriptive

The moth is decidedly dissimilar to that of the cabbage looper, having a greater wing expanse, nearly two inches, entirely different coloration, and differently shaped upper wings. The lower edges of the fore wings have a well-defined conical projection. The border is not scalloped, the color is somewhat purplish brown, the darker shades being velvety brown. The silver marks are very distinct. The hind wings are ochreous or yellowish brown, strongly banded with dark fuscous, particularly toward the white border. The ground color of the thorax, fore wings, and abdomen is duller than that of the hind wings. The lower surface is pale ochreous, with a rather distinct darker band running through both wings near the middle.

The egg is milky white, flattened, globular, or turnip-shaped, sometimes with an impressed spot in the center of the upper surface. The upper half of the egg is grooved vertically.

The larva is similar to the cabbage looper. The color is very pale yellowish green. The length is about $1\frac{1}{2}$ inches when fully extended.

* Chittenden, Division Entomological Bulletin 33, New Series.

Remedy

Paris green applied to the under side of the leaves.

Celery or Parsley Caterpillar

Papilio polyxenes Fab.
Family *Papilionidae*
Papilio asterias Fab.

General Appearance

The most evident forms of this insect are the feeding caterpillars, which are indeed very striking. The youngest of these are noticeably darker with yellow spots. When full grown they are yellowish green with distinct black bands and dots on the bodies. If disturbed they throw out a forked, orange-colored scent organ behind the head, which exhales a very pungent and characteristic odor. The eggs are about 1 mm. in length, at first yellow and later reddish brown in color, and flattened at the attached end. The adult butterflies are commonly known

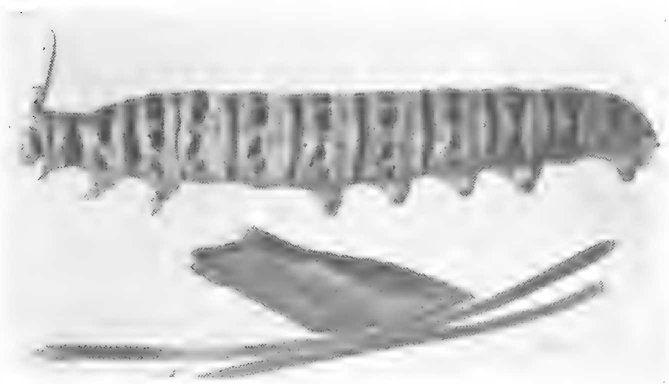

Fig. 1. Caterpillar and Chrysalis of the Parsley Butterfly (*Papilio polyxenes* Fab.) (Original.)

as the black swallowtails, being black with yellow markings. The chrysalids vary from green to dull gray and are more or less mottled. The zebra caterpillar is equally striking in appearance but smaller.

Life History

The eggs are laid upon the food plants from spring to early summer and hatch in about ten days. The caterpillars are voracious feeders and develop very rapidly, being ready to form chrysalids in about one month after hatching. Chrysalids hatch in about two weeks. The adults being strong fliers are able to scatter their broods over large areas. There are several generations a year.

Food Plants

In many localities this caterpillar is a serious pest of celery and parsley, but feeds also upon carrots, caraway, parsnips, dill, fennel and related wild plants.

Control

Though the caterpillars may be controlled by poison sprays on some crops, these are not safe for celery and parsley. The larvae are so conspicuous as to make hand picking one of the best methods of control. If care is exercised to collect and destroy the first larvae the second and more damaging brood will be greatly reduced. Concerted action on the part of all growers is necessary to bring satisfactory results.

Natural Enemies

The ichneumon parasites, *Trogus vulpinus* Grav. and *T. exidianator* Brulle, destroy great numbers of the chrysalids.

E. O. Essig

Grasshoppers

Some species of grasshoppers often prove destructive pests during the early part of the season, especially where the celery is planted near meadows or other habitat of these insects. Where no fowls are allowed to run, it is practicable to poison the grasshoppers by means of wheat bran to which there has been added molasses and water and enough Paris green to give the mixture a slightly green color.

Parsnip Louse. See under *Parsnip*.

Tarnished Plant Bug

This insect while not considered a dangerous celery insect, has been known to injure the crop in several instances. While young this bug is very small, being only about one-twentieth of an inch in length, of a yellowish or yellowish-green color, which changes to a faded yellow or dull brown when it is fully grown. It works especially where weeds abound and on crops that are somewhat neglected. As a preventive, keep the celery well cultivated and free from weeds, and do not allow any trash to lie over the ground beneath which the insects can pass the winter. Kerosene emulsion is moderately effective when

thoroughly applied. The insects are sluggish during the early morning and many of them can be caught by means of a large butterfly net; but in all cases it will be as necessary to destroy insects found upon surrounding crops and weeds.

ZEBRA CATERPILLAR. See *Celery Caterpillar*, this section.

CELERIAC, CULTURE OF. See *Alaska*.

CHECKING GROWTH, COVER CROPS FOR. See *Apple Orchard, Cover Crops.*

CHEMICAL COMPOSITION OF APPLES. See *Fertilization of Apple Orchard.*

CHEMICALS REMOVED BY VARIOUS CROPS. See *Apple Orchard, Cover Crops.*

The Cherry

The origin of the cherry, like that of many of our domestic fruits, is lost in the unwritten history of the evolution of plant life. If we could see the cherry from which all varieties of cherries have come, and then if we could see that from which this original cherry sprung, and so on back step by step until we reached a point beyond which we cannot go, there would at least be educational interest in it, and having traced one species back to its original, we might, with strong presumption of truth, say that this is the path all other fruits have trodden. Being denied this privilege, we classify the cherry under its genus, *Prunus*, and the seedling cherry under its species, *Avium*.

There is no doubt that certain varieties were introduced into this country from the older countries, but when they came there were cherries growing wild in this country that came from some source, no one knows where, and in all probability travelled the same path as the cherries of Europe or of the Orient, which under cultivation were improved and brought to this country in the improved state.

The wild cherry grew in the Atlantic states and in the Middle states as late as 1865, or even later. The writer came to Illinois about that time and settled on the prairies near a point of timber that skirted the stream called Bruiletts Creek. A little village called Cherry Point had sprung up at the point of timber, extending out into the prairie. In that skirt of timber there were cherry trees large enough to be manufactured into lumber, and they were used for the various purposes of fencing, building, etc.

At the time it did not occur to us to measure the trees, for we did not think their size was of much consequence, except as they could be utilized for the time being, but as we remember them now, they must have been 18 inches to 3 feet in diameter. Then, in the little groves on the prairies were cherry trees of smaller size that nearly always bore fruit. The fruit of the large and the small varieties was not the same in size or color, one being black and the other reddish, but they were cherries and there was no greater difference between them, than exists now between the light and dark colored fruits of the same name, but of improved varieties. In the hill lands of Oregon, near the coast are large wild cherry trees, highly prized for lumber.

From *Prunus Avium* the following varieties have sprung:

First. The Mazzards, or inferior seedling fruit of various shapes and colors, the trees often attaining great size.

Second. The Hearts, or heart shaped sweet cherries, light or dark, represented by the black Tartarian and Governor Wood.

Third. The Bigarreaus, or heart shaped, firm fleshed, sweet cherry, like the Napolean and Windsor.

Fourth. The Dukes, light colored, somewhat acid in flesh, such as the May Duke and the Reine Hortense.

From *Prunus Cerasus*, the following varieties have sprung:

First. The Armarelles, or light colored, sour cherry with colorless juice, represented by the Early Richmond and Montmorency.

Second. The Morellos, or dark colored, sour cherry with dark colored juice like the English Morello and Louis Philippe.

The Mahaleb is a type brought from the Old World, and is hardier and smaller

Lamberts. —Colville Photo.

than most other types, therefore is often used as a stock on which to bud, and on which to grow better varieties.

Soil Best Adapted

In its wild state, the cherry is generally found growing on a porous, sandy, moist soil. It will grow on a variety of soils, but it does best where the soil is not too wet, where there is not too much clay and where there is not a hardpan subsoil. For the best fruiting, there should not be too much humus in the soil, as this leads to a heavy wood growth; but it should be rich in mineral elements. The soil should always be well drained, and if the cherry orchard has not natural drainage, it should be tiled or drained with surface ditches; for the cherry tree will not do its best in a damp soggy soil. Further, during the early part of the year, when the tree is developing or ripening its fruit, there should be more water than in the latter part of the season, when it is passing into a dormant state.

Planting the Trees

As in the planting of other orchard crops, the soil should be well prepared, graded, pulverized and all roots, trash and other obstructions to subsequent cultivation, removed. This is especially important if the ground is to be irrigated; but is subject to some modifications in the humid climates, where irrigation is not practiced.

As to whether the square, hexagonal or some other method of planting is adopted, is a matter of choice, depending somewhat on conditions. See our article on planting under *Apple*.

The distances apart will depend on soil, climate, and the purposes of the grower; but most of all upon the varieties planted. For instance, the sour cherry, is not a large tree when it has reached maturity, and may be planted 20 to 25 feet apart, with reasonable assurance that the trees will not crowd each other when full grown. The sweet cherry will grow twice as large as the sour cherry,

Fig. 1. A Well Arranged and Well Cared for Cherry Orchard, Three Years Old.
—*Courtesy N. P. Ry.*

and will require nearly twice the space. Where there is plenty of moisture, the trees may be planted at less distance, as where there is barely enough; because where the water is scarce, the roots have to draw moisture from a larger area than where it is abundantly supplied.

Where there is plenty of water, and a rich soil, the tendency will be toward a heavy wood growth at the expense of heavy fruitage; while in regions where the soil is thin and the water scarce, the tendency will be toward heavy fruitage at the expense of wood growth. Under these latter conditions, the tree would probably lack vital force and be short lived.

Cherries as Fillers

It is common in some sections to plant an apple orchard, selecting other fruits as fillers to be planted between the rows of apples and to be cut out when the trees begin to crowd and the apples need the space. For this purpose, peaches, pears, and other fruits have been selected. The cherry is not adapted to this form of planting since it requires a different method of cultivation from any of the fruits named. It matures its crop early and requires the remainder of the season for the development of its fruit spurs for the coming year; also requires less water during this period, and less humus than the other crops.

The rules for the planting of the cherry, are but little different from those of any orchard fruits. It is important to have the holes large enough to receive the roots without crowding, and deep enough so that the tree is set a little deeper than when in the nursery. Tramp the soil well about the surface, to hold the tree from shaking in the wind.

The age of the tree at the time of planting is a subject of controversy and opinions differ, generally, with differing conditions. In the Northeastern states, and in Canada, the preference seems to be generally in favor of two-year-old trees. In the Western states, especially the Pacific coast states, the preference is in favor of one-year-old trees. This difference grows partly out of the fact that in the West, where the climate is milder, the seasons longer, and the lands are irrigated, the trees make a much more rapid growth than in the Northeast, and are approximately as large in one year as in the East in two years. Even where irrigation is not the rule in the Pacific coast regions, as in the Willamette valley in Oregon, or west of the Cascades in Washington, the climate is mild, the rainfall abundant and most abundant at the time the cherry most needs it; therefore, this region is peculiarly adapted to the growing of cherries. Under these conditions, we think the choice of one-year-old stock is decidedly preferable, to two-year-old stock. Further, the earlier in the life of the tree the head is shaped, the less it is damaged by cutting, and the better top it will form.

Cultivating a Cherry Orchard

For the first three or four years at least the cherry orchard should have clean culture. This does not mean that vegetables which require cultivation may not be grown among the trees. In fact, we think this is ordinarily an advantage rather than a disadvantage, because it does not injure the trees, insures cultivation, and utilizes much land that is otherwise wasted. It does mean that the growing of grass, especially blue grass, or timothy, is not favorable for the best growth of the trees. Much depends on the nature of the soil. West of the Cascades where the soil is rich in humus and where the tendency would likely be toward a heavy wood growth, a fall crop of oats, fall wheat or winter rye, might be grown. On the east side of the Cascades, where the soil is rich in mineral substances, but lacks nitrogen and humus, a cover crop of clover, peas, alfalfa, or vetch, might be grown. There are no rules that apply equally well under all conditions, and the orchardist must always decide for himself what are the soil and climatic conditions, and how they should be utilized in reference to the crop he is growing. The cherry, like all other trees, must be adapted to its environment in order to produce the best results. There is perhaps no part of the

United States where the natural conditions are more favorable for the growth of the best varieties of cherries, than the Pacific coast region, west of the Cascade mountains.

From the Oregon Experiment Station we learn that as high as 500 to 800 pounds of cherries have been grown from a single tree, and that from $100 to $200 per acre net profit is not unusual; but that the money realized often runs as high as $600 to $700 per acre. I think that for Washington, these figures might be easily duplicated, although in exceptional cases, I have seen larger yields.

GRANVILLE LOWTHER

Cost of Harvesting Cherries

The following statement was reported from Ohio to Green's Fruit Grower (Feb., 1912).

No. crates per acre	530
Average price per crate	$2.00
	$1,060.00
Picking, per crate	$0.48
Crate (new)	.25
Express	.20
Commission	.20
Total	$1.13
Total cost of harvesting	$598.90
Net returns per acre	461.10

This covers harvesting costs only and the crop was an unusually large one.

Propagation of Cherries

W. L. HOWARD

The cherry is propagated almost entirely by budding. While seedlings from our common varieties may be used for growing stock, nurserymen always use special kinds of stock which are usually imported from France. The kinds of stock in most general use are the Mazzard and Mahaleb. The Mazzard is the best stock for both sweet and sour cherries in the East. The Mahaleb is more widely used for the sour kinds, however, for it is easier to bud, and is free from leaf blight in the nursery. The Mazzard, however, appears to form a better root system, stronger union, makes a longer lived tree and is sufficiently hardy. For the plains states the hardier Mahaleb stock should be used. Both of these may be secured from most any nurseryman in early winter or spring. In a small way, it is quite feasible to grow one's own cherry stock from the seeds of the fruit raised at home.

Fig. 2. Royal Anns Properly Packed. For Rules for Packing Cherries see Packing under Apple.

Cherry seeds should not be permitted to become thoroughly dried out at any time. On this account it is advisable to store the seeds through the remainder of the summer, after ripening, in boxes of sand and bury them from eight to twelve inches deep in the ground in a cool place. This will keep them moist, and at the same time they will be sufficiently cool and away from the free circulation of air that they will not begin to grow.

At the approach of cold weather the seeds should be taken up and the open boxes of sand kept on the surface of the ground in the shade of a building throughout the winter. Very early in the

spring the seeds should be planted in nursery rows four feet apart and an inch or two apart in the rows. Cover with an inch or two of fine soil, if the ground is not too wet. If the seeds are about to sprout and the soil is yet too wet to work well, the seeds should be partially covered with the wet earth and then a dressing an inch thick of well-rotted manure spread over the rows.

The young seedlings should have thorough cultivation during the summer. About the last week in August or the first week in September, or earlier, if the bark peels readily, the budding should be done. In the South where the spring opens much earlier, the seedlings may be large enough for budding in June. In that event, one year's time is saved, as the tops are cut off immediately, and the young trees often grow to transplanting size the same season. Full details for the budding is given under the discussion of peaches. When the trees have had one year's growth from the buds, they are of the proper age to be transplanted to the orchard. Cherry seedlings are sometimes cleft-grafted in spring, where the buds the previous fall failed to take.

Pruning the Cherry

The cherry has the annoying habit of occasionally producing strong shoots from adventitious buds along the trunk of the tree or from near the surface of the ground. A close watch should be kept for such interlopers in order that they may be promptly removed.

Framework

During the early years of the growth of the cherry care should be exercised to secure a proper distribution of the limbs which are to form the framework branches of the tree, particularly with the sweet cherries, as this species has the unfortunate habit of dividing into two shoots of nearly equal size with a close angle between, which always forms a weak joint. Trees not carefully pruned to overcome this bad habit are liable to severe injury from splitting when heavily loaded with fruit.

Cutting Back

In the early period of the growth of the sweet cherry, the annual growth will need more or less severe cutting back, depending upon soil and climatic conditions, in order to maintain them within bounds. On general principles this heading should be done just before growth starts in the spring.

Fruiting Habits

The fruiting habits of the cherry are more closely allied to those of the apple and the pear than to the peach, and for that reason the shortening of the annual growth is of less moment than with the peach.

Pruning First Four Years

W. S. Thornber

During the first four years of a young cherry tree's life in the orchard it should be carefully, systematically and regularly pruned. By this time it should be large enough and its frame work so well developed that the future pruning would consist largely of the removal of dead, diseased, broken or crossed limbs and an occasional heading back or thinning out of the fruiting wood. Pruning for the production of wood after a tree starts to bear should not be necessary as there is a relationship existing between the amount of wood produced and the size of the crop borne, in the case of most varieties of cherries.

How to Prune

The first and most essential pruning of a cherry tree should take place just previous to the beginning of its second year's growth. When one-year-old trees are planted in the orchard, immediately after transplanting, is a good time to give it this pruning. All lateral branches should be cut off close and the top headed back to from 24 to 36 inches from the ground. The purpose of this pruning is to establish a low headed spreading tree rather than a high upright tree. The young tree will require no further pruning until the beginning of the third year's growth unless a very strong sprout springs from the root or on the main stem six inches or less from the ground, necessitating immediate removal.

At the beginning of the third year's growth from three to five of the best branches should be selected to form the frame work of the tree. The remainder should be cut off and those headed back to from one-third to one-half of their original length, cutting to outer buds always and maintaining the most central one as a leader, which should be from four to six inches longer than the rest. These branches should be selected with special reference to their position on the main stem and to one another. They should have wide angles, no two should be opposite and be as far apart as possible on the main stem.

The pruning for the fourth and fifth year's growth should be very much the same as for the third, using special care to thin the tops and cut back in such a manner as to spread the top as much as possible. After this only the necessary pruning should be done, as heavy pruning tends to produce wood growth which is not at all desirable in bearing trees.

When to Prune

The pruning of young growing trees should be done late in the winter or early in the spring, but never early in the winter.

CHERRIES IN ALASKA. See *Alaska*.

Cherries—Trees, Production and Value
U. S. Census 1910

Division or State—	—1910— Trees of bearing age	Trees not of bearing age	—1909— Production (bushels)	Value	1899 Production (bushels)
United States	11,822,044	5,621,660	4,126,099	$7,231,160	2,873,499
Geographic Divisions:					
New England	68,236	32,587	14,904	38,424	23,445
Middle Atlantic	1,851,144	659,953	791,326	1,541,708	775,587
East North Central.....	3,853,974	1,523,247	1,410,298	2,362,344	851,326
West North Central.....	2,768,659	1,117,533	515,690	935,537	297,873
South Atlantic.........	1,063,825	364,118	327,706	394,990	391,799
East South Central.....	453,262	257,112	94,873	143,166	49,457
West South Central.....	385,502	242,569	9,954	14,401	13,635
Mountain	390,644	581,641	147,854	300,485	33,956
Pacific	986,798	842,900	813,494	1,500,105	436,421
New England:					
Maine	14,288	6,653	2,403	7,164	1,550
New Hampshire........	9,463	6,326	1,403	4,133	1,183
Vermont	18,006	6,659	2,506	7,651	1,069
Massachusetts	13,396	6,776	4,761	10,848	6,043
Rhode Island	964	453	214	464	1,329
Connecticut	12,119	5,720	3,617	8,164	12,271
Middle Atlantic:					
New York	673,989	342,959	271,597	544,508	218,642
New Jersey	102,124	36,743	44,636	87,225	82,005
Pennsylvania	1,075,031	280,251	475,093	909,975	474,940
East North Central:					
Ohio	1,144,271	342,328	338,644	657,406	192,954
Indiana	815,742	251,959	363,993	508,516	228,485
Illinois	843,283	239,605	287.376	453,474	204,279
Michigan	760,183	540,580	338,945	590,829	194,541
Wisconsin	290,495	148,775	81,340	152,119	31,067
West North Central:					
Minnesota	25,139	38,399	1,526	2,973	960
Iowa	908,764	229,352	260,432	455,022	118,743
Missouri	622,332	247,425	123,314	222,510	62,708
North Dakota	5,076	21,484	209	445	4
South Dakota	51,613	76,293	5,924	12,981	900
Nebraska	494,468	267,529	89,876	164,872	54,047
Kansas	661,267	237,051	34,409	76,734	60,511
South Atlantic					
Delaware	16,145	4,598	2,634	4,850	8,066
Maryland	82,305	27,774	42,315	60,121	60,452
District of Columbia....	435	4	235	568	248
Virginia	352,783	83,323	132,671	134,428	188,693
West Virginia	332,429	124,567	79,723	111,043	87,828
North Carolina	168,065	74,111	53,788	60,453	33,899
South Carolina	60,274	25,764	10,987	15,880	6,551
Georgia	50,723	23,479	4,979	7,199	5,950
Florida	666	498	374	448	112
East South Central:					
Kentucky	212,118	102,766	52,163	74,340	34,258
Tennessee	201,830	128,406	36,303	60,294	11,688
Alabama	25,566	16,673	3,588	4,783	1,159
Mississippi	13,748	9,267	2,819	3,749	2,352

Cherries—Trees, Production and Value—Continued
U. S. Census 1910

Division or State—	1910 Trees of bearing age	1910 Trees not of bearing age	1909 Production (bushels)	1909 Value	1899 Production (bushels)
West South Central:					
Arkansas	60,046	47,556	5,993	8,424	7,889
Louisiana	975	760	527	921	336
Oklahoma	295,042	150,541	2,372	4,393	*3,221
Texas	29,439	43,712	1,062	663	2,189
Mountain:					
Montana	19,938	24,237	7,497	17,985	807
Idaho	61,381	95,423	22,609	41,766	12,294
Wyoming	919	4,025	68	251	1
Colorado	203,806	319,624	88,937	173,895	5,387
New Mexico	21,925	26,818	6,384	10,684	5,228
Arizona	812	1,608	476	840	220
Utah	70,775	109,119	21,402	54,170	9,905
Nevada	1,588	787	481	894	114
Pacific:					
Washington	241,038	229,067	131,392	278,547	52,114
Oregon	223,456	313,770	181,089	269,934	65,347
California	522,304	300,063	501,013	951,624	318,960

* Includes Indian Territory.

Varieties of cherries recommended for cultivation in the various districts of the United States. See map on page 192.

District No. 1

HIGHLY RECOMMENDED — *Dessert and market*: Tartarian, *Black*. *Kitchen*: Bessarabian; Brusseler Braune; Lutovka.

RECOMMENDED — *Dessert, kitchen and market*: Ostheim. *Kitchen and market*: Large Montmorency; Montmorency Ordinaire; Morello, *English (Wragg)*; Richmond, *Early*. *Dessert and kitchen*: May Duke. *Market*: Amarelle Hative; Shadow Amarelle. *Kitchen*: Dyehouse; Philippe, *Louis*.

District No. 2

HIGHLY RECOMMENDED — *Kitchen and market*: Large Montmorency; Montmorency Ordinaire; Morello, *English (Wragg)*; Richmond, *Early*. *Dessert and market*: Black Heart; Eagle, *Black*; Elkhorn; Elton; Hortense, *Reine*; Rockport; Tartarian, *Black*; Windsor; Wood, *Governor*. *Dessert and kitchen*: May Duke; Olivet. *Market*: Napoleon *(Royal Ann)*. *Dessert*: Eugenie, *Empress*; Spanish, *Yellow*. *Kitchen*: Bessarabian; Dyehouse; Late Duke; Late Kentish.

RECOMMENDED — *Dessert, kitchen and market:* Ostheim. *Dessert and market:* Downer; Lewelling. *Dessert and kitchen:* Archduke. *Dessert*: Choisy, *Belle de*; Coe *Transparent*; Early Purple *Guigne*; Knight *Early*; Mezel. *Kitchen*: Carnation; Lutovka; Magnifique, *Belle*; Philippe, *Louis*; Royal Duke.

District No. 3

HIGHLY RECOMMENDED — *Kitchen and market*: Large Montmorency; Montmorency Ordinaire; Richmond, *Early*. *Dessert and market*: Black Heart; Tartarian, *Black*. *Dessert and kitchen:* May Duke; Olivet. *Market*: Napoleon *(Royal Ann)*. *Dessert*: Coe *Transparent*; Spanish, *Yellow*. *Kitchen*: Late Kentish.

RECOMMENDED—*Kitchen and market*: Morello, *English (Wragg)*. *Dessert and market*: Downer; Eagle, *Black*; Elton; Hortense, *Reine*; Rockport; Windsor; Wood, *Governor*. *Dessert*: Choisy, *Belle de*; Mezel. *Kitchen*: Late Duke; Magnifique, *Belle*; Philippe, *Loui*; Royal Duke.

District No. 4

HIGHLY RECOMMENDED — *Kitchen and market*: Large Montmorency; Montmorency Ordinaire; Morello, *English (Wragg)*; Richmond, *Early*. *Dessert and market*: Black Heart; Hortense, *Reine*; *Windsor*. *Dessert and kitchen*: May Duke. *Market*: Napoleon *(Royal Ann)*. *Kitchen*: Dyehouse; Late Duke.

RECOMMENDED — *Dessert, kitchen and market*: Ostheim. *Dessert and market*: Downer; Eagle, *Black*; Elton; Tartarian, *Black*; Wood, *Governor*. *Dessert and kitchen*: Olivet. *Dessert*: Choisy, *Belle de*; Coe *Transparent*; Early Purple

Guigne; Eugenie, *Empress;* Spanish, *Yellow.*

RECOMMENDED FOR TRIAL—*Dessert, kitchen and market*: Suda *Hardy.*

District No. 5

RECOMMENDED — *Kitchen and market*: Large Montmorency; Morello, *English (Wragg);* Richmond, *Early. Dessert and market*: Eagle, *Black;* Elton; Rockport; Tartarian, *Black;* Windsor; Wood, *Governor. Dessert and kitchen*: May Duke. *Market*: Napoleon (*Royal Ann*). *Dessert*: Coe *Transparent;* Choisy, *Belle de;* Early Purple *Guigne;* Knight *Early;* Mezel; Spanish, *Yellow. Kitchen:* Dyehouse; Late Duke; Magnifique, *Belle.*

District No. 7

RECOMMENDED—*Kitchen and market*: Montmorency Ordinaire. *Dessert and market*: Black Heart. *Kitchen*: Magnifique, *Belle;* Plumstone *Morello.*

District No. 8

HIGHLY RECOMMENDED — *Kitchen and Market*: Large Montmorency; Montmorency Ordinaire; Richmond, *Early;* Morello, *English (Wragg). Kitchen:* Late Kentish.

RECOMMENDED—*Dessert, Kitchen, and market*: Ostheim. *Dessert and market*: Eagle, *Black;* Tartarian, *Black;* Wood, *Governor. Dessert and kitchen*: Olivet. *Market*: Napoleon (*Royal Ann*). *Dessert*: Spanish, *Yellow. Kitchen*: Carnation; Dyehouse; Lutovka; Philippe, *Louis;* Plumstone *Morello.*

RECOMMENDED FOR TRIAL — *Dessert, kitchen, and market*: Suda *Hardy. Kitchen:* Bessarabian; Brusseler Braune; Northwest.

District No. 9

HIGHLY RECOMMENDED — *Kitchen and market*: Large Montmorency.

RECOMMENDED—*Dessert, Kitchen, and market*: Ostheim; Morello, *English* (*Wragg*). *Market*: Amarelle Hative. *Kitchen*: Bessarabian; Brusseler Braune; Lutovka.

RECOMMENDED FOR TRIAL — *Market*: Shadow Amarelle. *Kitchen*: Dyehouse.

District No. 10

HIGHLY RECOMMENDED — *Dessert and kitchen*: Olivet.

RECOMMENDED — *Kitchen and market*: Large Montmorency; Morello, *English* (*Wragg*); Richmond, *Early. Dessert and market*: Wood, *Governor. Dessert and kitchen*: Archduke; May Duke. *Market*: Napoleon (*Royal Ann*). *Kitchen*: *Dyehouse;* Late Duke; Lutovka.

District No. 12

HIGHLY RECOMMENDED — *Kitchen and market*: Large Montmorency; Montmorency Ordinaire; Richmond, *Early;* Morello, *English* (*Wragg*). *Dessert and Market*: Hortense, *Reine;* Republican, *Black;* Windsor. *Dessert and kitchen*: May Duke. *Market*: Napoleon (*Royal Ann*). *Dessert*: Choisy, *Belle de;* Eugenie, *Empress;* Knight *Early. Kitchen*: Late Duke; Royal Duke.

RECOMMENDED — *Dessert and market*: Black Heart; Eagle, *Black;* Tartarian, *Black;* Wood, *Governor. Dessert and kitchen*: Archduke; Olivet. *Dessert*: Coe *Transparent;* Spanish, *Yellow. Kitchen*: Dyehouse; Philippe, *Louis;* Plumstone *Morello.*

District No. 13

HIGHLY RECOMMENDED — *Kitchen and market*: Morello, English (*Wragg*).

District No. 14

HIGHLY RECOMMENDED — *Kitchen and market*: Morello, *English* (*Wragg*). *Dessert and market*: Lewelling; Tartarian, *Black;* Windsor. *Dessert and kitchen*: May Duke. *Market*: Napoleon (*Royal Ann*). *Kitchen*: Late Duke.

RECOMMENDED—*Dessert, Kitchen, and market*: Ostheim. *Kitchen and market*: Late Montmorency. *Dessert and market*: Elton; Republican, *Black;* Wood, *Governor. Dessert*: Spanish, *Yellow. Kitchen*: Late Kentish; Philippe, *Louis.*

RECOMMENDED FOR TRIAL—*Dessert and kitchen*: Olivet. *Kitchen*: Dyehouse.

District No. 15

HIGHLY RECOMMENDED — *Kitchen and market*: Richmond, *Early. Dessert and market*: Bing; Hoskins; Lambert; Lewelling. *Market*: Napoleon (*Royal Ann*). *Kitchen*: Late Kentish.

RECOMMENDED — *Kitchen and market*: Morello, *English* (*Wragg*). *Dessert and*

market: Oxheart; Tartarian, *Black;* Wood, *Governor. Dessert and kitchen*: May Duke. *Dessert*: Early Purple *Guigne;* Spanish, *Yellow. Kitchen*: Late Duke.

District No. 16

HIGHLY RECOMMENDED—*Dessert and market*: Bing; Tartarian, *Black. Market*: Napoleon (*Royal Ann*).

RECOMMENDED — *Kitchen and market*: Richmond, *Early. Dessert and market*: Lewelling; Rockport.

District No. 17

HIGHLY RECOMMENDED—*Dessert and market*: Tartarian, *Black. Market*: Napoleon (*Royal Ann*).

RECOMMENDED — *Dessert and market*: Centennial.

RECOMMENDED FOR TRIAL—*Dessert and market*: Lewelling.

District No. 18

RECOMMENDED — *Kitchen and market*: Morello, *English* (*Wragg*). *Dessert and market*: Tartarian, *Black;* Centennial. *Market: Napoleon (Royal Ann).*

CHERRY DISEASES

Black Knot

Plowrightia morbosa Schw.

This is a conspicuous disease attacking the branches of cherry and plum trees but is more frequent upon the cherry varieties of the Morello type. It is due to a parasitic fungus. Insects, however, make harbors of the interior of the knots. The spores of the black knot fungus are ripened during the winter and scattered in early spring, finding lodgment on the new branches or in fractures on old ones, where their growth causes the formation of a new knot. Black knot may be prevented by spraying with Bordeaux mixture, but is more profitably controlled by carefully cutting off affected parts and burning them, making a clean sweep at least once each year and that *previous to March 1st.* This is a practicable measure and we have confidence in its efficiency.

(The disease occurs on wild cherries in the Northwest—Ed)

A. D. SELBY,
Wooster, Ohio.

Brown Rot

Sclerotinia fructigena

H. S. JACKSON

The rot caused by *Sclerotinia fructigena* on many stone fruits, is sometimes serious also on cherries. Moist weather conditions near the ripening time are favorable for the rapid development and spread of the disease. The fruit is more susceptible as it becomes mature. The disease makes its appearance on the cherry as a small brown spot, which gradually enlarges until the whole fruit is affected.

A general discussion of this disease together with recommendations for its control, will be found under Peach diseases.

Black Cherry Twig Blight

Sclerotinia seaveri Rehm

Has been found on wild cherry in New York.

Cherry Gummosis

H. P. BARSS

The term "gummosis" by itself denotes simply the abnormal development of gummy or mucilaginous substances, resulting in the formation of gum pockets or exudations from various parts of the plant. The tendency to gum formation is characteristic of plums, apricots, peaches, cherries and other stone fruits wherever grown, usually as a response to injury, disease or unsuitable conditions of soil, climate, etc. Citrus and other trees are often subject to similar gumming. We are concerned here, however, with this phenomenon as it appears on the cherry, especially on the sweet varieties in the Northwest.

Of the two groups of cherries, the sour cherries or *Prunus cerasus group*, and the sweet cherries or *Prunus avium* group, we find that the former are not nearly so susceptible to gum flow, while the latter seem particularly subject to serious attacks whenever they are cultivated, if we can judge by the reports that come from such widely separated points as Australia, Europe and the Pacific coast.

In the state of Oregon serious attacks of gumming in the cherry orchards were noticed at least as early as 1853, very

early in the history of fruit raising in the Northwest.

It is not known to what extent the cherry industry in other parts of the United States suffers from the presence of gummosis. Little is heard from it in the drier, eastern portion of the Northwest; but in the moist valleys of Washington and Oregon, west of the Cascades, at least, the trouble now reaches such proportions as to dishearten many cherry growers and discourage other orchardists from planting cherries. The conditions demand a thorough investigation as to the causes, means of prevention and possible remedies.

Various Causes of Cherry Gummosis

As has been intimated, the formation and exudation of gum is to be considered as the result of an injured, diseased or otherwise abnormal condition of the tree. It is a symptom only and not the disease itself. The published literature on cherry gummosis brings to light many explanations for the appearance of this phenomenon, some well proved and others more or less theoretical.

Injuries

Mechanical injuries, such as bruises, may induce the formation of gum, but the wound usually heals quickly and the gumming ceases. The injection of certain chemicals into cherry trees has repeatedly caused gum flow, and such insects as borers may produce it; but these causes need not engage our attention.

Unfavorable Soil and Climatic Conditions

A disturbed or disordered physiological condition of the tree, produced by unsuitable soil, moisture, climate or other relations not perfectly understood, is undoubtedly an important factor and possibly even a primary cause in many cases of gummosis. It is often noticeable that trees set in low places, where excessive moisture is likely to be present, are more apt to be subject to the disease than those on better drained ground. But this cannot explain all, since some trees under the best of soil and moisture conditions are severely attacked. Gumming seems to be worse where soils or subsoils are poor or unfit. But may not a weakened condition of the trees due to such causes render them less resistant to definite diseases? Many good authorities in this country and Europe attribute to late frosts following warm spells many attacks of this trouble. Some methods of pruning and cultivation have also been held responsible for a certain amount of gummosis. While all these factors have, no doubt, some influence on gum-production, yet investigation reveals so many cases inconsistent with these explanations that we must look for other possible causes.

The Attacks of Fungi

Since the outbreak of a serious cherry disease in Germany in 1899 various bark-destroying fungi have been found associated with the disease. From observations up to the present it does not seem very probable that any of these are responsible for more than a small amount of injury to living trees in the Northwest. It is possible, however, that they play a more important role than has been suspected.

There also appear frequently on the trunks and limbs of dead or diseased cherry trees certain fungi of the wood-rotting types. Being found not infrequently on trees that are not totally dead, they have been suspected by some of having a hand in extending the diseased condition. It is not known, however, that these fungi have anything directly to do with the disease in question.

Description of the Disease

Numerous distinctly different troubles of the cherry may be accompanied by gum-production, hence, the term "cherry gummosis" should not be applied to any specific disease. It is my present opinion, however, that the greater part of the cherry trouble in the Northwest is due to a single disease appearing in a variety of forms between which there are hardly distinguishable gradations.

The More Serious Phases of the Disease

The condition most dreaded is where trunk and limbs are quite generally attacked. This may appear at its worst

during the third and fourth year after setting out. Little indication of the disease may be present until tree or branches fail to leaf out or suddenly wilt during the growing season. In these cases girdling has previously taken place. There may or may not be gumming and little relation appears between the amount of gumming and the extent of injury. In the later stages there is usually no difficulty in detecting the disease on account of the fact that no further growth takes place at the affected region, while the adjacent and still healthy parts add a new layer of wood during the growing season. The dead area then appears flattened, and, the dead bark, since it does not expand, frequently, though not always, splits open. In other words, we have the formation of a canker.

More Restricted and Localized Cankers

In this disease we find certain conditions in which a large part of the tree may be rapidly and often fatally involved in a general attack, or in which large dead areas are formed that may girdle trunk or limbs, but the disease does not always appear in such severe forms, and we commonly find small cankers and affected spots that are more restricted and localized appearing on various parts of the tree. Near the center of such spots one frequently discovers the remains of a dead bud or spur. This association of small cankers with dead buds is not universal, but it is so common that it suggests the possibility that the diseased spot had its beginning in the death of the bud or spur. In connection with the dying of the tissue there is sometimes an abundance of gum production and sometimes very little where only a very small amount of tissue is found to be affected. Again, a canker may entirely girdle a branch with very little exudation occurring or none at all.

The Blighting of Buds and Spurs

There is a very common phase of our cherry trouble which has generally escaped the notice of the growers or has been passed by as unworthy of much attention. This is the blighting of buds and fruit spurs, generally accompanied by gumming, which is present in practically all cherry orchards to a greater or less extent, but is much worse in orchards

A Species of Polyphorus.

A Species of Polystictus

An Imperfect Fungus.

Fig. 1. Saprophytic Fungi Which Are Often Present in Half Dead Cherry Trees.

Fig. 2. Tree Showing the Serious Effects of the Disease on the Trunk, Crotch and Limb Bases, a Dangerous Condition. This is avoided by limb-grafting upon mazzard seedlings.

where trunks and limbs are badly diseased. Old trees and younger trees seem to be equally affected. This trouble is first noticeable early in the spring when some of the buds, which formed normally in the fall, fail to swell and open when the others unfold. (See Fig. 3.) A drop of gum often appears exuding from the bud or from the affected spurs. (See Fig. 4.) Sometimes affected buds unfold, but before the blossoms open, wilt down and dry up. Often, however, spurs come into full leaf and set fruit, only to die a week or two later. As far as our observation goes, blighting of this sort does not usually take place during the summer or fall.

The amount of damage directly produced by this form of disease is not very serious in most cases, but the after effects are probably much more important than has been supposed. Investigation shows that after a spur or bud has been blighted, a small area of discoloration usually spreads out from its base onto the branch. This is almost always confined at first to the outer layers of the bark. As in the case of larger cankers, a layer of wound cork eventually separates the diseased tissue from the healthy substance of the branch. The following season, however, the diseased area may spread farther

Fig. 3. Cherry Branches Showing Blighted Spurs Failing to Develop at Blossoming Time.

Fig. 4. Examples of Spur Blight Due to Bacteria. Drops and masses of gum ooze out from the dead spurs.

from the base of the spur, up and down the branch and also, more slowly, around it. The inner parts of the bark and the cambium become affected and a typical canker of small size results. Very often girdling follows and the whole end of a branch may be killed by a canker at its base. Practically all of the dead shoots which so often appear in the top of a tree during the year, seem to be caused by cankers spreading out from spurs or buds that died in some previous season or at the beginning of the same season.

Pseudomonas cerasus, Griffin, the Cause of Spur Blight

In March, 1909, Mr. F. L. Griffin found bacteria associated with blight of cherry buds. Inoculations with cultures produced the characteristic blight. Repeated tests were made during the next two seasons with buds from various districts, with the same results. Careful morphological and physiological studies led him to believe that a new species had been discovered and he accordingly described it under the name *Pseudomonas cerasus.*

This organism, then, seems to be the cause of one form of cherry gummosis. How much it has to do with other phases of the disease only further investigation can show.*

Recent Experiments and Observations

In February, 1912, the writer began his investigation of cherry gummosis and since that time has confirmed many of Mr. Griffin's previous observations and conclusions. Furthermore, the repeated discovery of bacteria similar to *Ps. cerasus* in the diseased areas on trunks, limbs or twigs, and the production of gumming by subsequent inoculation with these organisms, gives strong support to the idea that bacteria cause the characteristic injuries found on the bodies of trees affected with this disease.

Summary of Experiments and Observations

To sum up the result briefly: 1. The experiments of Mr. Griffin and the writer seem to indicate that a species of bacterium (*Ps. cerasus*) is responsible for the blighting and gumming of buds and spurs on common varieties of the sweet cherry. 2. This bacterium is also able to induce gumming when inoculated into the body and branches of these varieties. 3. Bacteria similar to *Ps. cerasus* have been found during the spring in nearly all spreading cankers on the trunks and limbs as well as in diseased spurs, and these, by inoculation into healthy trees, are able to induce gumming. 4. From observations made through one season only, it appears that the disease progresses rapidly in the spring and only slowly or not at all during the summer and autumn. 5. It is impossible to state positively from our present knowledge that bacteria are responsible for all the more serious phases of the disease on

* See Science, N. S. 34, No. 879, p. 615, November 3, 1911.

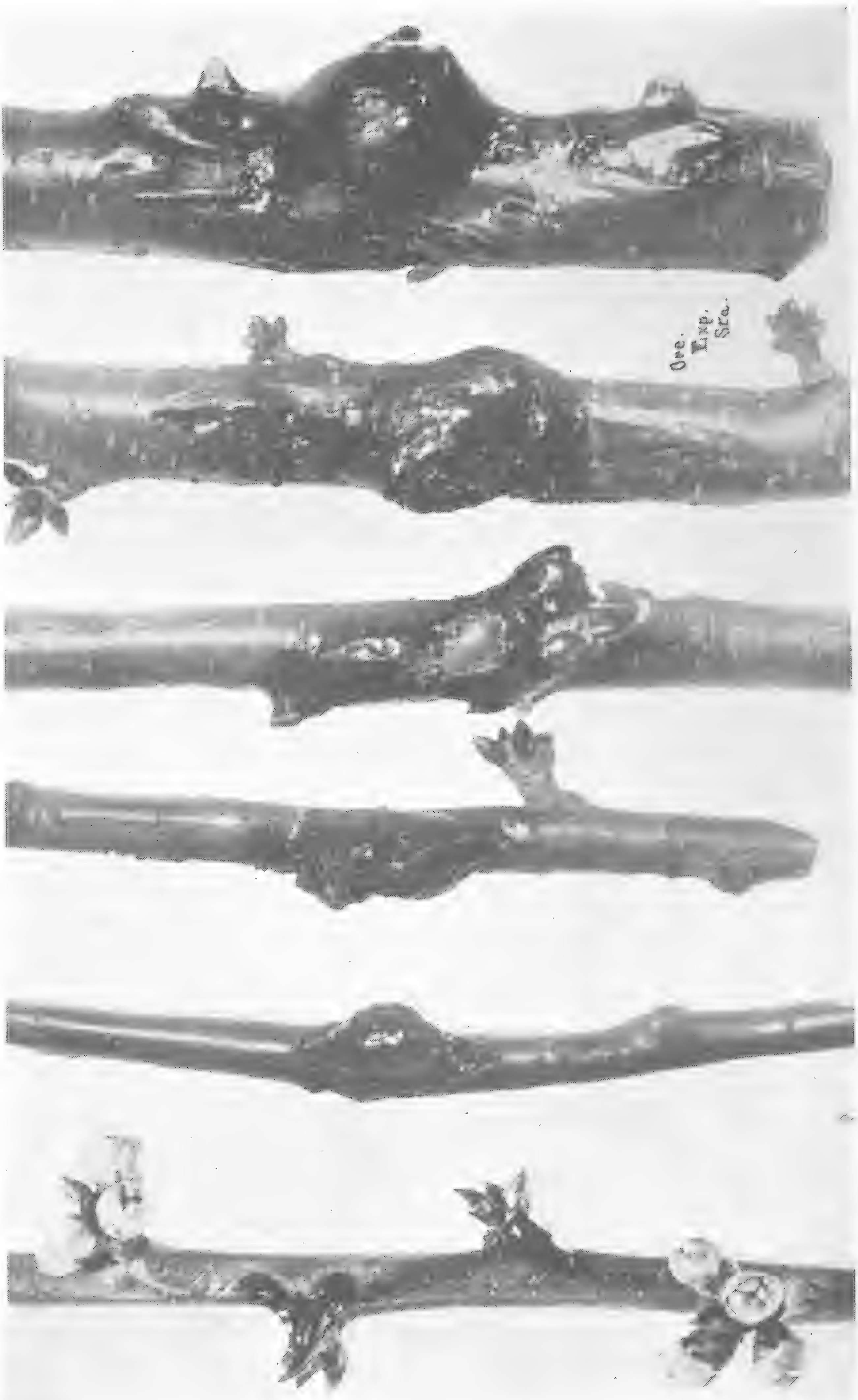

Fig. 5. A Series of Cherry Twigs Showing How Cankers May Develop Along the Branch, Spreading from the Bases of Blighted Spurs. A dead bud or spur was found near the middle of each canker. Bacteria like those causing the spur blight are in the advancing margins of such cankers.

the body of the tree, or to indicate just what part they play in its spread. The possibility of their being causative agents seems, however, to receive considerable support from the recent investigations.

Experiments must be carried on over a number of years before the nature of the disease can be demonstrated beyond a doubt, or recommendations for its control can be made with assurance. The relation which climatic and soil conditions, the attacks of insects or fungi, and the methods of cultivation have to the disease, must be studied thoroughly. This will take time and the cherry grower must not be impatient.

Prevention and Control

More important in the eyes of the practical orchardist than the cause, is the remedy for the disease.

Resistant Stocks and Varieties

The Mazzard Cherry as a Stock

Attention has been called to the fact that winter injury and unfavorable soil conditions may have a great deal to do with the appearance of gummosis in the cherry. It may be that the more serious phases of the disease cannot occur without a previous injury or weakened vitality due to some such factors. It is well known, both in this country and abroad, that the so-called Black Mazzard cherry is generally much hardier and less liable to suffer from adverse conditions than are the cultivated varieties. Hence, seedling Mazzards have come to be much used in Europe as stocks upon which to graft the commercial sweet varieties. In this country also the Mazzard is coming to be recognized as a sturdy stock which unites with the sweet cherries better than the Mahaleb. A point in favor of the Mazzard as a stock is that it seldom "gums." To make use of Mazzard stock and to graft or bud on the limbs the variety desired, gives trunk, crotch and limb bases that are practically free from trouble. If the disease then appears in the top, it cannot involve the entire tree and experience seems to show that the branches are much less liable to suffer from gumming when the body of the tree is clean.

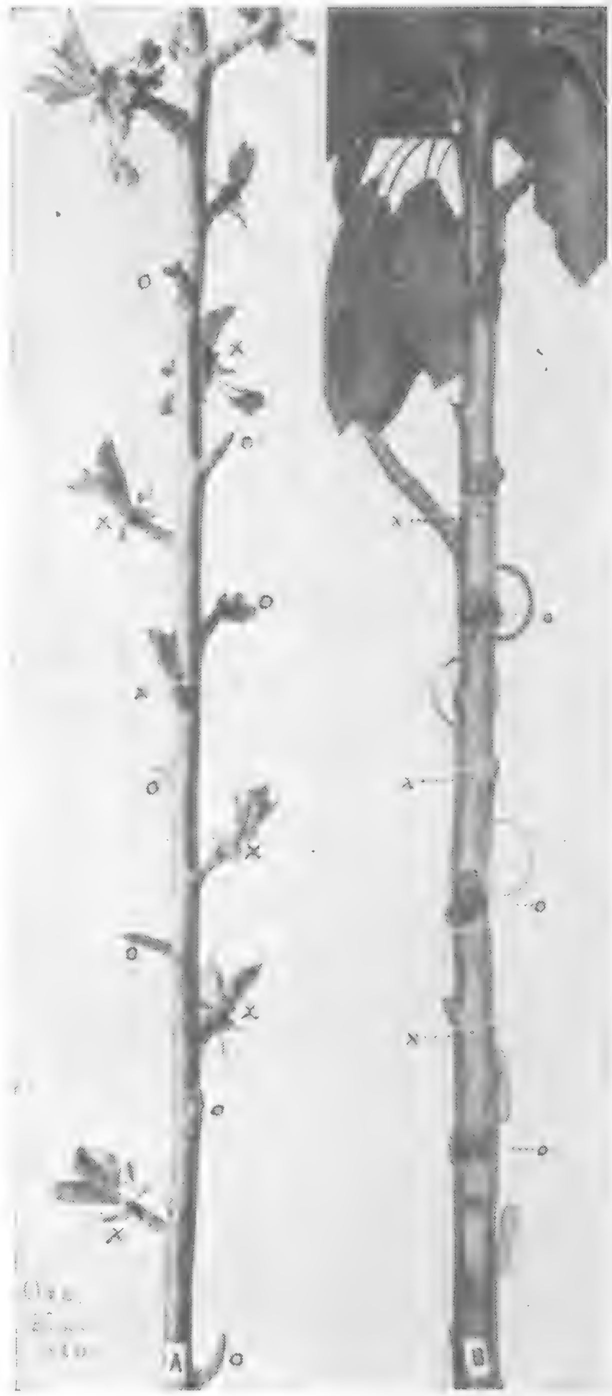

Fig. 6. The Results of Artificial Inoculation with *Ps. Cerasus*. (O) Indicates an inoculation. (X) A check puncture with sterile needle. A. Blighting of inoculated spurs. Checks opening normally. B. Gum exuding at points of inoculation on the body of two-year-old tree. The check punctures healed.

Examination of orchards aggregating some thousand trees supposed or known to be top-grafted upon Mazzard stocks showed 80 to 91 per cent free from any indication of disease on the trunks where orchards not upon this stock were found, to have, in some case, over 60 per cent and in one case over 80 per cent of the trunks badly cankered or killed by the disease. The writer is convinced that the use of the Mazzard as a stock on which to limb-graft or bud the other varieties, is a thoroughly practical way

of protecting the cherry from this disease in its most damaging form. Figs. 8 and 9 are illustrations of this method.

Other Resistant Stocks

Various other stocks, including the Morello, the Dukes and a native cherry (*Prunus demissa*) have been recommend-

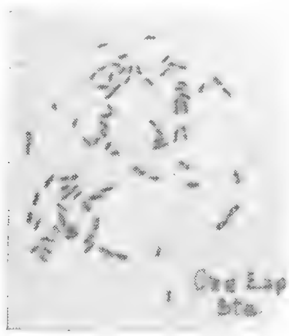

Fig. 7. Bacteria Which Induces Gumming of the Cherry. Magnified 500 Diam.

ed as hardy and resistant stocks on which to work the sweet cherry, but until these have been tried out further, the writer strongly advises the use of the Mazzard on account of the present evidence in its favor. A word of warning should be given here against unscrupulous dealers who sometimes palm off seedlings of doubtful lineage as Mazzards. There are, however, reliable nurseries from which satisfactory stock may be obtained.

The Lambert Cherry

The three varieties of sweet cherries most extensively grown for commercial purposes in Oregon are the Royal Ann,

Fig. 8. A Year's Growth on a Tree Top-Grafted on the Limbs of Mazzard Seedling Cherry. Trunk and limb bases are free from gummosis, where this method is adopted. This form of crotch is undesirable.

Bing and Lambert. These are all subject to gummosis, but the Lambert has had the reputation of being less seriously affected than the other two. Observations in orchards in different sections seem to substantiate the general opinion.

Table Showing the Relative Effects of the Disease Upon Royal Ann, Bing and Lambert Trees in an Orchard near Salem, Oregon

Variety	Total number trees	Totally destroyed	Half destroyed	Badly diseased	Moderately diseased	Slightly diseased	Unaffected
Royal Ann	259	37%	13%	22%	27%	1%	0%
Bing	222	36%	15%	24%	24%	1%	0%
Lambert	259	13%	8%	9%	36%	31%	3%

The argument in favor of the Lambert in this orchard is striking.

In budding or grafting the susceptible varieties, it is a matter of good sense to select scions or buds from trees which seem particularly healthy and free from gummosis. In nearly every badly infested orchard there are trees of the Royal Ann or Bing varieties which seem to be healthier and freer from disease than the rest. Such may, perhaps, be more resistant than their neighbors, and

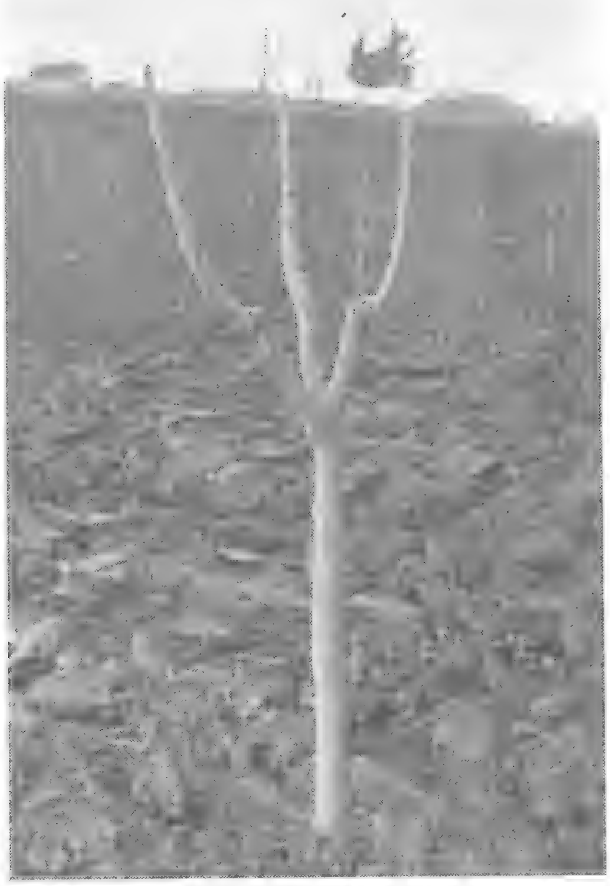

Fig. 9. Top-Budded on Mazzard Seedling and Headed Back to Produce Stocky Growth. The mazzard body is gummosis resistant. This form of crotch is undesirable.

that resistance may possibly be transmitted by the scion.

Cultivation

Thorough cultivation in the early part of the season is beneficial to the cherry, but spasmodic or irregular cultivation is considered harmful. As far as cherry gummosis is concerned, a tree assisted by proper cultivation and making a vigorous and rapid growth as a result, has a better chance to recover from and outgrow the trouble than a weak tree.

Cutting Out the Disease

The most successful method of treatment in practice among careful cherry raisers consists in the thorough cutting-out early in the season of all diseased, discolored and gum-soaked bark. Persistent watch is kept by frequent inspections and as soon as new diseased spots are discovered, they are cut out. Where this has been conscientiously done, and the injuries have been cut out before getting very large, the recoveries have often been rapid and the damage from the disease rather small. In cutting out, it is important that all the tissues which are in any degree affected should be removed. The wound thus made should be sterilized, preferably by the application of a solution of corrosive sublimate (1-1000); when dry, large wounds should be coated with walnut grafting wax* as a protection against the entrance of destructive wood-rotting fungi. It is often impossible to discover at once all the affected tissue around a gum exudation or canker, and a second or third cutting-out may have to be made during a season, but persistence will be rewarded in most cases by a rapid healing of the wound through the growth of new callus tissue over it. Care should be taken not to remove any more of the living and healthy tissues than is necessary in cutting out the disease.

Where a small branch is affected, it is often better to remove it entirely and allow a healthy one to take its place. In young trees it is strongly recommended to remove all blighted spurs and cut away discolored tissues that spread out from their base; since our investigations lead us to suspect that many of the serious cankers originate in this way.

Spraying seems to be practically useless as a means of control for cherry gummosis. Slitting of the bark has been recommended by many growers, but we cannot see that much benefit results except where a gum pocket is opened and the gum is prevented by release of pressure from spreading under the bark. On the contrary, where trunks or limbs have been slit deeply, bad wounds are sometimes produced, and instances of apparent spreading of the disease along the slit argue against the practice.

Other recommendations with regard to treating the diseased trees have been made by various growers. The cutting out of the cankers, however, has resulted in local benefit in so many well-authenticated instances under the writer's observation, that he does not hesitate to urge

* The formula for making Walnut Grafting Wax is given in the Oregon Agricultural Experiment Station Bulletin No. 111, p. 96.
See under Walnut.

growers to adopt this practice. Although it takes time and patience, it pays in the end. The time to begin is when the trees are very young. Small cankers can be easily cut out, but an old tree full of disease is an almost hopeless case to work on.

Summary of Recommendations

1. Use a resistant stock like the so-called Mazzard cherry, and graft or bud into the branches to secure a trunk and crotch practically free from gummosis.

2. The Lambert cherry is recommended as being somewhat more resistant to the disease than the Royal Ann and Bing varieties.

3. Good cultivation in the spring is urged as promoting a vigorous and healthy growth and rendering the trees more likely to resist the spread of the malady.

4. The cutting out of diseased tissue and sterilizing of the wound will check the development of cankers in many cases, especially if taken in the earliest stages. New orchards should be carefully inspected for several years and all affected spots treated as soon as discovered.

A Partial List of Important Works Relating to Cherry Gummosis

Aderhold, R. *Ueber das Kirschbaumsterben am Rhein, seine Urschen und seine Behandlung.* Arb. K. Gsndhtsamt., Biol. Abt. 3, No. 4, 1903.

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Beijerinck, M. W., and Rant, A. *Sur l'excitation par traumatisme, le parasitisme et l'ecoulement gommeux chez les amygdalees.* Arch. Neerland. Sci. Exact. et Nat., Ser. 2, 11, p. 184, 1906.

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Butler, O. R. *A Study on Gummosis of Prunus and Citrus.* Ann. Bot. 27, No. 97, p. 107, 1911.

Frank, A. B., and Kruger, F. *Das Kirschbaumsterben am Rhein.* Deut Landw. Presse. 1899, p. 249.

Griffin, F. L. *A Bacterial Gummosis of Cherries.* Science N. S. 34, No. 879, p. 615, Nov. 3, 1911.

McAlpine, D. *Fungous Diseases of Stone Fruit Trees in Australia.* Bul. Dept. Agr. (Victoria), 1902, p. 67.

Mikosch, K. *Untersuchungen uber die Entstehung des Kirschgummi.* Sitzber. K. Akad. Wiss. (Vienna), Math. Naturw. Kl. 115, No. 6, p. 911, 1906.

Prillieux, E. *Etude sur la formation de la gomme dans les arbres fruitiers.* Compt. Rend Acad. Sci. 78, p. 135, 1874.

Sorauer, P. *Untersuchungen uber Gummifluss und Frostwirkungen bei Kirschbaumen.* Part 1, Landw. Jahrb, 39, p. 259, 1910. Part 2, Landw. Jahrb. 41, p. 131, 1911.

Die Back

Cherry trees are subject to injury from unfavorable conditions of soil, moisture, etc. As a result of such injuries the trees frequently die back from the top and suffer severely in this way.

This trouble can be controlled only by planting on soil which is particularly suited to the cherry and by determining the best root stock for any given type of soil or locality.

Trees in which die back and gummosis are produced by unusual climatic conditions should be cut back in the top to sound wood, and have the trunks protected from sunburn by whitewash or wrapping.

Fruit Drop

Fruit falls to the ground while small and undeveloped. The trouble is common to many fruits and is due to conditions of climate which lie outside of ordinary control, or to lack of proper pollination, which may be controlled by planting suitable varieties for cross-pollination. Rains occurring at blossoming time or frost at a critical time may have this effect.

R. E. SMITH,
California Experiment Station, Bulletin 218.

Leaf Curl or Witches' Broom

Exoascus cerasi

H. S. JACKSON

This disease is quite common in the Northwest, but is not yet very serious. It is caused by a fungus, *Exoascus cerasi*, which attacks the branches. The affected

branch is not killed, but the presence of the fungus stimulates it to an unnatural and prolific formation of twigs, resulting in the peculiar "witches' broom" effect. These witches' brooms may be large or small, and are especially conspicuous at blossoming time, since they produce few flowers or none at all, while the leaves appear sooner than those on the normal parts of the tree. These leaves, which are penetrated by the fungus, are reddish in color and somewhat wrinkled or wavy. Not long after they become fully expanded the spores of the fungus are produced all over the surface and the affected leaves fall prematurely.

Control

Since the witches' broom produces no fruit, and is a drain on the rest of the tree, and a source of new infections, we recommend that the affected branches be cut off, a few inches below the diseased portion, and destroyed.

Leaf Spot or Shot Hole

Cylindrosporium padi

H. S. Jackson

There are several leaf spot and shot hole diseases which are more or less common on various stone fruits; but the greater part of this sort of injury on the cherry and plum is due to the fungus called *Cylindrosporium padi*. The trouble caused by this organism on the Pacific coast is not usually severe enough to alarm growers, but there is reason to think that the extent of damage is underestimated. While the amount of leaf area which is destroyed by the fungus is generally not very extensive, the presence of the shot hole spots on the leaves often results in partial defoliation, and in bad cases, even in total defoliation of the tree. This is naturally a severe check on its development. At the points where the infections take place, a small brownish spot appears. This enlarges, and may be surrounded by a reddish border. After a time, the dried center of the spot becomes detached from the margin and falls out, leaving the shot hole effect. On some varieties of cherries the center does not drop out, however, as it does in our common sweet varieties. The disease is spread by means of spores produced in the affected spots and the fungus probably survives the winter in the fallen leaves from which, in the spring, spores are carried to the new foliage by the wind.

Control

The disease can be largely controlled by spraying. According to W. M. Scott, of the United States Department of Agriculture, who experimented in Illinois, self-boiled lime-sulphur 10-10-50, commercial lime-sulphur 1-40, and a weak Bordeaux mixture 2-4-50, are equally effective. Recent experiments by Butler in Wisconsin indicate, however, that Bordeaux is more effective than commercial lime-sulphur. It is recommended that the spray be applied three times: First, half way between blossoming time and the ripening of the fruit; second, just after picking; third, about one month after the second.

Mushroom Root Rot. See under *Apple*.

Powdery Mildew. See under *Peach*.

Shot Hole. See *Leaf Spot*, this section.

Witches' Broom. See *Leaf Curl*.

CHERRY PESTS

Bud Moth, Eye Spotted Bud Moth. See under *Apple Pests*.

Cherry Aphis. See *Aphids*.

Cherry Fruit Fly

Rhagoletis cingulata Loew

H. F. Wilson

Unfortunately, due to the habits of this insect, the grower does not know of its presence until the cherries are mature. If left to hang on the tree or uneaten for several days after picking, the presence of a full grown maggot is shown by the rotting and shrinking of one side of the fruit, and about that time the maggots leave the fruit for the purpose of going to the ground, where they pupate and remain over winter. The adult fly resembles the common apple maggot very closely and may prove to be the same insect. Somewhat smaller than the common housefly, the general color is black with lateral borders of thorax light yellow, and head and legs yellowish-brown. Wings with five, more or less distinct black bands,

three of which lie angled to each other and join at the front edge of the wing near the tip. These flies deposit the eggs from which the yellowish-white maggots or ' worms" issue and work in the fruit around the pits. This causes a kind of rotting and softening of the fruit on one side.

Just when the fruit is entered is not known, but the life of the maggot is probably about three weeks, and as the mature stage is reached about the time the fruit is ripe, some idea of the time they enter the cherry may be gained. Since the larvae remain in the fruit for a short time after it is picked they may be distributed quite a distance in fruit The adults are not strong fliers and can hardly do more than to spread from tree to tree or at the most from orchard to orchard.

Remedies

No very satisfactory remedy is at present known, although a great many have been tried.

Cherry Fruit Sawfly

Hoplocampa cookei Clarke

The cherry fruit sawfly is a native of California and other Pacific coast states and has been known since 1883 in the Suisun valley, California.

Considerable damage to young cherries has been done in various sections by the larvae of this insect and occasionally, at least, control measures may be necessary.

The presence of the insect may be told by the small round holes bored in the young green cherries, many of which soon drop to the ground.

The larvae are small, white and average about one-fourth of an inch in length. The adults are four-winged insects, black with brownish or reddish appendages, about one-eighth of an inch long.

Control measures have not been thoroughly perfected but two applications of arsenate of lead at the rate of four to five pounds to 100 gallons of water, the first applicatiòn to be made shortly before the blossoms open and the second about 10 days later, have proven effective. Fall plowing is also recommended to kill the larvae and pupae in the soil while a distillate-oil emulsion and nicotine spray is recommended to kill adults at time of egg laying.

The insect has been reported as occurring in the Suisun valley, El Dorado and Nevada counties, California, and at Medford, Oregon, where it is confined to a very small area.

The orchard fruits attacked are cherry (sweet and sour), prune, plum, peach and apricot (the peach and apricot only occasionally).

The females appear about the time the Black Tartarian cherries are in bloom. The eggs hatch about the time the petals fall.

E. O. Essig

Cherry Leaf Beetle

Galerucella cavicollis

In September a small, dark red beetle, less than one-fourth inch long, may be found feeding on the leaves of cherries. The antennae and parts of the legs are black. It is partial to the wild cherries, and also feeds on peach and plum. This is the cherry leaf beetle. It may be destroyed in the fall by spraying with arsenate of lead, three to five pounds in 50 gallons of water.

H. A. Gossard

Cherry Scale

Eulecanium cerasorum Ckl.

General Appearance

The full-grown scales are exceedingly large, often obtaining a height of three-eighths of an inch, though the average is slightly over a quarter of an inch. The general shape is hemispherical, and the bodies are very irregular and lobed. The general color is rich brown, mottled with creamy white. The markings are more or less regular and constant. The entire surface is highly polished and shiny.

Food Plants

This scale works upon the branches of cherry and pear trees, collecting in such great numbers as to do considerable damage.

Control

Same as for black scale on deciduous fruit trees or for the European fruit scale.

E. O. Essig

Fig. 1. The Cherry Scale, *Eulecanium cerasorum* (ckll) on Pear. Slightly reduced. (Original.)

Cherry and Pear Slug

Caliroa cerasi Linn

H. F. Wilson

This insect is a common pest of pear, cherry, plum and other fruit trees, and although not hard to control often causes considerable damage. The name "slug"

Fig. 1. Cherry Leaves Injured by Slugs.

Fig. 2. Adult of Cherry and Pear Slug.

is applied on account of the slimy black exudation with which the larva surrounds itself.

It appears to be a native of Europe and was known as a pest as far back as 1740. In America the distribution seems to occur with the areas where its principal host plants are found. A large number of trees, including forest and orchard trees, have been reported as attacked by this insect, but cherry, pear and plum are said to be the favorite plants.

When present in any locality the larvae soon make themselves familiar to the fruit grower both by their appearance and by the injury which they do.

In the Northwest we have found but two complete broods with some indication that there may be a partial third. The first adults appear in early spring, but for some reason the eggs do not develop or are not laid until May or June; as soon as they hatch the young larvae begin feeding on the leaves and from that time until the leaves drop the slugs are present in varying numbers. Most of them, however, are found in two distinct periods: the larvae of the first generation appear more abundant during June and July; the larvae of the second generation are most numerous during August and September.

Webster has worked out the following schedule for Iowa:

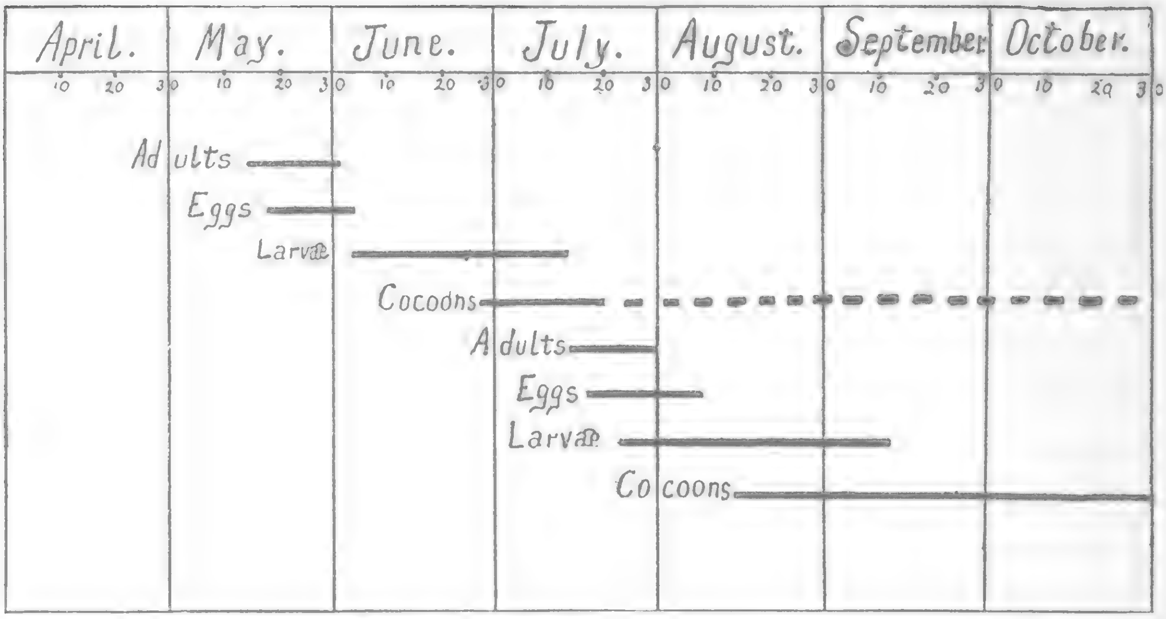

Fig. 3. Diagram of Life Cycle.
(Iowa Bulletin 130.)

When present in large numbers, they soon cause the leaves to become brown and the trees to look as if they had been badly scorched by fire. The adult insect is a small shining black fly with four smoky transparent wings, the smoky appearance being caused by a dusky band across the middle of the wings. On account of the saw-like ovipositor with which the insect makes incisions into the leaves, this insect and a number of closely allied species are known as saw flies.

Life History and Habits

Searching out a suitable place, the adult fly pushes the ovipositor rather slowly into the under surface of the leaf and makes a small oval-shaped pocket into which the egg is placed by means of the ovipositor. When the pocket is being made the tissues are so cut as to prevent their growing around the egg and destroying it or preventing the escape of the larva.

Fig. 4. Larva of Cherry and Pear Slug.
—*After Ewing.*

The egg is almost colorless and is flattened on the lower side. As soon as the eggs hatch the young larvae make their way to the upper surface of the leaf and begin feeding. At first they are yellowish white in color and without slime. In a very short time, however, as the slime spreads over the body, they change to a dirty green and have more the appearance of a slug than of an insect. Immediately upon hatching they begin feeding on the upper tissue of the leaf, eating out numerous small patches, so that a number of slugs working on the same leaf will leave nothing but the dead brown skeleton of veins.

After completing their moults the larvae do not feed any more, but crawl or drop to the ground, work their way into the soil from one to three inches and pupate. After moulting the last time, they do not again assume the slimy protection, and instead of being green they are of a yellowish orange color with two minute black eyes. After the larvae crawl into the ground an oval cell about five-tenths inch long by three-sixteenths inch wide is made.

Fig. 5. Pupa Cases of Cherry and Pear Slug.

When disturbed these cells are very easily broken apart, a fact which might indicate that fall plowing can be used as a method of destroying the pupae, according to Marlatt.

"During the heated season of July and August the transformation from the larval to the adult insect is quite rapid, the pupal stage being assumed in from six to eight days, and the adult flies transforming and digging out through the soil some 12 or 15 days after the larva entered it."*

According to the studies of Peck and Marlatt some of the larvae of this spring brood remain over in the soil until the following spring. This seems to be a provision of nature to carry the species over, should anything happen to exterminate the regular line of succession, such as lack of food, unfavorable climatic conditions, etc.

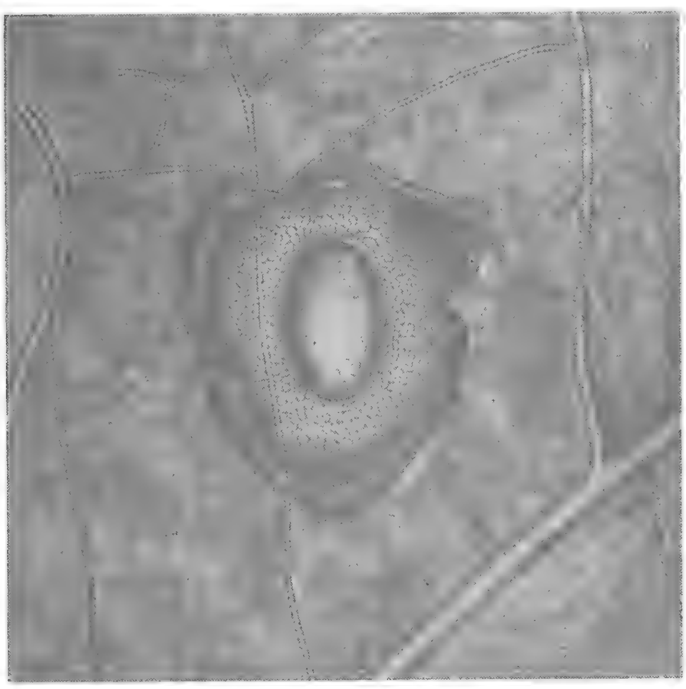

Fig. 6. Egg of Cherry and Pear Slug.
—*After Ewing.*

* C. C. Marlatt, U. S. Department Agriculture, Bureau of Entomology Circular 26, Second Series 1897.

Natural Enemies

Although furnished with a sticky covering which acts as a repellant against all enemies, the insect is not entirely free from insect enemies, and in Europe some half dozen insect parasites have been reared from it. In this country a minute fly is said to sting the egg through the upper leaf tissue.

Remedies

White hellebore, one pound to 50 gallons of water. No foliage is injured and the slugs are nearly all dead on the day following the application of spray.

"Black leaf-40" gives practically the same results as white hellebore and does not injure the foliage. "Black leaf-40" is more expensive to use than the hellebore.

Hellebore is the best remedy to use for cheapness, efficiency and lack of injury to the foliage. To get best results it must be fresh and free from adulteration.

Arsenate of lead is cheaper but does not kill as quickly and may injure the foliage.

CURCULIO. See under *Plum Pests.*

Divaricated Buprestis
Dicerca divaricata

A flatheaded borer found beneath the bark. May be treated the same as the flat headed apple tree borer, which see under *Apple Pests.*

Dogday Cicada or Dogday Harvest Fly
Cicada linnei

Deposits its eggs in the twigs of cherry and other trees. The musical notes or drumming of the male cicada during the middle of the day is a familiar sound during August and September. Injury by this insect is generally slight and it is scarcely necessary to trim out and burn the twigs containing eggs.

Emperor Moth
Callosamia promethea

Until late in September, full-grown caterpillars of the Promethea Emperor moth may be found feeding on the leaves of cherry, especially of the wild species. This is a large, bluish white, or bluish

green caterpillar, about 2½ inches long, with 4 yellow or red tubercles or horns on the thoracic segments, i. e., on the two posterior rings bearing feet; there is also a large horn of similar color on the back of the 12th segment, counting from the head. When full fed, the caterpillar draws the opposite edges of a good sized leaf together, thus making a kind of cylinder, except that the ends are closed, and within this it spins a very tough, light-colored cocoon. The stem of the leaf, enclosing the cocoon, is attached by a strong band of silken threads to the twig which produced it. So strong is this connecting band that it cannot be broken except by a very strong pull. The cocoons may be clipped from the trees and burned after the leaves have fallen. No other remedy than hand-gathering is needed when the worms are feeding.

H. A. Gossard,
Wooster, Ohio.

Ermine Moth. See under *Apple Pests.*

Fall Canker Worm

Alsophila pometaria Harris
Family Geometridae

General Appearance

In all of its stages this insect greatly resembles the spring canker worm *(Paleacrita vernata* Peck), but differs in that the larvae have three pairs of legs on the posterior half of the body instead of two and the bodies are more distinctly striped. The primary wings of the males also have an extra light band near the middle. The eggs are shaped like small flower pots, being smaller at the bottoms than at the tops, with distinct darker circles at the tops. They are deposited in regular clusters of from fifty to two hundred, standing side by side in exposed places.

Life History

The life history is practically the same as that of the spring canker worm, but the eggs are deposited in a compact mass and glued to the twigs and covered with hairs from the female's body in the late fall or during the milder portions of winter, as late as March. The young hatch about the same time as those of the spring forms and work about the same. The adults issue from October to December, or as late as spring, and immediately crawl up the trunks to deposit their eggs.

Food Plants

The foliage of the apple, prune, cherry, apricot and other fruit trees are attacked.

Control

Control measures as adopted for the spring canker worm may be used for this (See under *Apple Pests.*) Bands around the tree trunks will not prove as effectual, because of heavy winter rains, unless they are occasionally renewed. These barriers must be put in place during September and October and continued until spring.

E. O. Essig

Fall Web Worm. See under *Apple Pests.*

Frosted Scale. See under *Apricot Pests.*

Fruit Bark Beetle. See under *Apple Pests.*

Ivy or Oleander Scale. See *Apple Pests.*

Leaf Crumpler. See under *Apple Pests.*

Peach Borer. See under *Peach Pests.*

Pear Blight Beetle. See *Shot Hole Borer*, this section.

Pear Thrips. See under *Pear Pests.*

San Jose Scale. See under *Apple Pests.*

Scurfy Scale. See under *Apple Pests.*

Smaller Shot Hole Borer

Xyleborus saxeseni Ratz
H. F. Wilson

This little cylindrical beetle is quite similar to the shot hole borer in appearance, but is only about one-half as large. The burrows are also quite dissimiliar in nature, and on comparison can readily be distinguished.

The above species apparently works upon the same trees and under the same conditions as the larger species, and so far as we know, never enters perfectly healthy trees. The life history is not definitely known for the Northwest, but in general is about as follows:

The adults reach maturity in the spring

or summer, and making their burrows in some diseased tree deposit eggs which later hatch out into small white grubs. These are the larvae and remain in that stage through the summer and winter transforming to pupae and adults in the spring. The burrow, instead of being a series of short tunnels, is one large cavity with sides parallel and about the width of the full grown beetle. The sides extend straight up and down and the eggs are indiscriminately deposited in a single mass. It is believed that this insect attacks only unhealthy trees.

Shot Hole Borer or the Pear Blight Beetle

Xyleborus dispar Fabricus

H. F. Wilson

There is no evidence that shot hole borers attack healthy trees in the Northwest under ordinary conditions.

Contrary to all reports from Europe and other parts of the United States there appears to be but one brood in this section.

Classification

The *Scolytidae* or engraver beetles, constitute a large and important group of beetles, many of which are very destructive to forest trees. From an economic standpoint the members of this family may be divided into two general groups, those attacking healthy living plants and those attacking plants in a more or less sickly or *dying* condition. Observations made in the Northwest by the writer indicate that *Xyleborus dispar* is distinctly a member of the second group.

Fig. 1. Heart Rot Fungus (*Schizophyllum sp.*) in Cherry, Issuing Through Burrows of (*Xyleborus dispar*).

History

The widespread distribution of this insect in Europe would indicate its being native to that country. We can only theorize on the time and means of importation into the United States, but the time must have been several years prior to 1816. About this time the insect was attracting some attention in Europe and has continued to receive more or less attention by different writers up to the present date.

Distribution

This insect is found in nearly all parts of Europe and England and is gradually spreading into certain sections of Canada and the United States.

Occurrence in the Northwest

The first reported injury in the Northwest which was in Clarke county, Washington, came in 1901, where a grower thought that a great many prune trees were being killed by the beetles. At the same time the beetles were working in Oregon near the city of Portland. In looking over the many inquiries which have been received during the past ten years it is interesting to note the gradual spread of the insect up the Willamette valley until now it is at Junction city, a distance of 125 miles south of Portland.

At the present time the distribution extends through the lower part of the valley on both sides of the river as far as the foot hills. The infested territory is increasing quite rapidly and the borers will in time undoubtedly spread over the entire western part of Washington and Oregon. From Portland to Salem, Ore., a distance of 53 miles, they are very abundant across the entire valley, and few dying trees escape their attack.

Nature and Extent of Injury

The real injury caused by these beetles seems to be almost, if not entirely, secondary. Many of our orchardists upon finding sick and dying trees with the shot hole borer working in them have attributed the cause to the beetles.

By visiting many of these places and explaining to the orchardist the true conditions, we have convinced them that the trees were suffering from some fungus disease or improper soil condition.

The beetles may help to kill the trees and in some cases might cause the death of trees which would have recovered from the disease had the beetles not been present. In the case of young trees, only one or two years old, this could readily happen, as the burrows extend almost entirely around the trees and close to the inner bark. (For example see Fig. 2.)

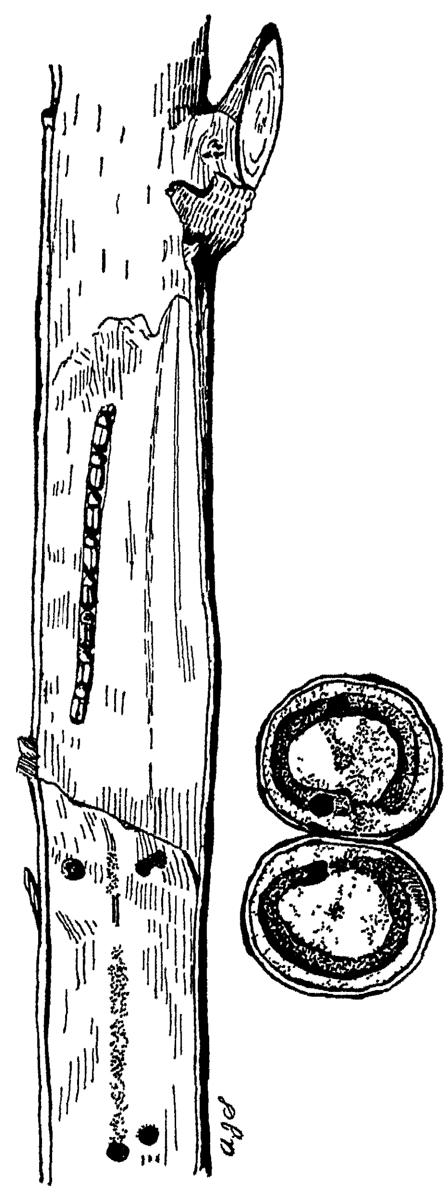

Fig. 2. The Shot Hole Borer. Burrow in young cherry tree and adults in hibernation

In the summer, after the beetles have completed the burrows, such trees can easily be broken off at the point of injury.

Life History

The winter is spent in the adult stage. Both males and females hibernate in the burrows from July and August until the following spring. They emerge during the last of March and first of April and migrate to sick and dying trees, where the burrows of that season are to be made. The entrance hole is usually made about a bud scar or in some roughened place. The beetles have no trouble in picking out the sick trees.

The Adult

The adult bores directly through the bark and into the wood tissue for a quarter of an inch or more and then begins the construction of branch burrows extending at right angles to the main burrow and with the grain of the wood. These channels are all about one-twelfth inch in diameter and from three-quarters to two and a quarter inches in length.

The Egg

The eggs may be found from the second week in April until the middle of June. When first deposited they are oblong in shape and pearly white in color. They measure 1 mm. in length by 0.06 mm. in diameter and will stand considerable rough handling. There seems to be no regularity in the egg deposition, as there may be from one to seven in each chamber of the burrow, placed without discrimination.

The burrows are not all made at once but are completed in sections, the female spending her time meanwhile between depositing eggs and resting near the entrance to the burrow. When the first branch chamber is finished the mother beetle deposits in it from one to seven eggs, and the fungus food of the larvae having been arranged for, she closes the entrance with frass and pays no more attention to it. The entire burrow is usually completed by the middle of May and then the mother beetle returns to the entrance where she stands guard until the following winter.

In the fall, when the beetles have matured, if some of the burrows are opened, both males and females can be found, the females usually outnumbering the males four or five to one.

During the hibernation period the adults apparently do not feed, as the fungus upon which the larvae feed is almost entirely absent in burrows opened at various times during the winter and there is no evidence of wood burrowing.

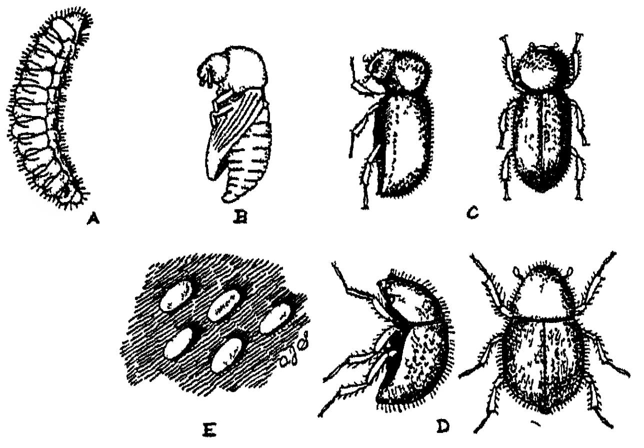

Fig. 3 The Shot Hole Borer (*Xyleborus dispar*). A, Larva; B, Pupa; C, Adult Female; D, Adult Male; E, Eggs.

Host Plants

This insect will apparently work and develop in all kinds of deciduous fruit and forest trees and has been reported as working in conifers. The following fruit trees are reported: apple, pear, quince, cherry, prune, plum, hawthorn, apricot, white hawthorn, grape and pomegranate. Nearly all writers on this subject agree that the beetles favor dying trees to healthy ones and several of them state that freshly cut logs and stumps are excellent breeding places. In the Northwest we have found them working in cherry, prune, apple, pear and chestnut. Cherry and prune are attacked more because those two trees appear to be more subject to diseased conditions than any of the others. Many cherry trees, especially young ones, die each year from the disease known as cherry gummosis. Prune trees are found growing in all manner of places and a great many in unsuitable surroundings. Naturally many of them succumb, and in addition there seems to be a disease similar to that of the cherry which destroys a great many. Both of these fruits develop what is commonly known as sour sap, a condition known to be favorable for the development of the fungus food upon which the larvae feed.

An occasional apple orchard is found infested, and I have observed a few pear trees showing attacks of this insect.

The Food of Xyleborus Dispar

The fungus upon which the larvae feed is evidently carried to the burrows by the females, since it appears in each burrow almost as soon as started.

The earlier entomologists seem to have been in doubt as to the nature of the food found in the brood chambers. Hubbard, 1897, gives a discussion on this fungus. He writes as follows:

"The ambrosia does not make its appearance by accident or at random in the galleries of the beetles. Its origin is entirely under the control of the insect. It is started by the mother beetle upon a carefully packed bed or layer of chips, sometimes near the entrance, in the bark, but generally at the end of a branch gallery in the wood. In some species the ambrosia is grown only in certain brood chambers of peculiar construction. In others it is propagated in beds, near the cradles of the larvae. The excrement of the larvae is used in some and probably in all the species to form new beds or layers for the propagation of the fungus.

"There must be present a certain amount of moisture or sap, and the sap in most species must be in a condition of fermentation."

As the fungus develops the growth forms into little globules containing the spores.

"The young larvae nip off these tender tips as calves crop the heads of clover, but the older larvae and the adult beetles eat the whole structure down to the base, from which it soon springs up afresh, appearing in little white tessellations upon the walls."

Natural Enemies

Eichhoff, 1881, reports *Calydium filiforme*, *Oxylaunus caesus* and *Hypophlosus bicolor* as found in the chambers of *Xyleborus dispar* and probably feeding upon the brood and eggs of the latter.

Schwarz, 1891, reports finding *Bactridium cavicolle* in breeding cages of *Xyleborus dispar*, and supposes that they are predacious on the larvae and eggs of this insect. We have as yet found no natural enemies of this insect in Oregon, probably owing to its recent importation.

(See also Lesser Shot Hole Borer, this section.—Ed.)

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SPRING CANKER WORM. See under *Apple Pests.*

TENT CATERPILLAR. See under *Apple Pests.*

TUSSOCK MOTH. See under *Apple Pests.*

WALNUT SCALE. See under *Walnut Pests.*

WHITE PEACH SCALE. See under *Peach Pests.*

CHINESE APPLE. See *Apple, Botany of.*

CHOKE BERRY. See *Apple, Botany of.*

Chestnut Culture

Commercial chestnut culture is beginning to take a place among the permanent horticultural industries of the United States. The enormous annual crops of small, sweet chestnuts, and the lack of appreciation of the value of the chestnut in the dietary of Americans have held back the systematic improvement of the American type into large, desirable kinds, and discouraged, for many years, the introduction of improved varieties from Europe or Asia. A few European seedlings have been growing for nearly a century within fifty miles of Wilmington, Delaware, and Philadelphia, Pennsylvania, where the history of the European chestnut in America largely centers. In all this time, but few orchards or groves have been developed, and only within a few years have any of the seedlings been selected for commercial propagation.

History of the European Chestnut

The European chestnut, which is popularly called the "Spanish Chestnut," was introduced into the United States, not for economic purposes, but by individuals who wished to determine its adaptability to their private estates. Nearly all of the varieties now in propagation are descendants from the French "Marrons," and the appellation "Spanish" is an anomaly. New varieties are not being extensively introduced from Europe at present, but many persons have planted the nuts of the best naturalized kinds, like the Paragon, hoping to discover among the variable progeny, seedlings that are superior to their parents.

The earliest history of the European chestnut, in America, is hidden in obscure book notices, or in the note books of those who were interested in early American agriculture.

The introductions that mark the beginning of the general dissemination around Wilmington and Philadelphia were those of Eleuthere Irenee du Pont de Nemours, who, with his family, emigrated from France to America in 1799, and after a residence at Bergen Point, N. J., where he took much pleasure in propagating a number of European seeds and plants received from France. It can be inferred from Mr. du Pont's journals and correspondence, that he planted a number of French chestnuts in his garden at Eleutherean Mills, Christiana Hundred, near Wilmington, Delaware, in the spring of 1803, and it is certain that a considerable number of trees became established and flourished there, some of which are still in existence.

To many of his friends he sent nuts or scions from his famous French Marrons, and from these chestnuts a multitude of seedlings sprang up and are still standing along the fence rows or in the gardens.

A few of these surviving seedlings, by attracting the attention of enterprising nurserymen, have thereby entered the variety ranks, but there are numbers that have long lain in obscurity, which, if introduced, might justly claim varietal distinction. The history of the named varieties is much confused, for it is based, in many cases, on the uncertain memory of those who have been longest acquainted with the trees.

History of the Japanese Chestnut

The development of the Japanese chestnut in America is the outcome of the systematic efforts of a number of nurserymen to introduce varieties from Japan, or to produce valuable seedlings from those already naturalized.

In 1876, the S. B. Parsons Co., Flushing, N. Y., imported a few trees from Japan through the late Thomas Hogg. (Fuller). The trees, Mr. S. B. Parsons writes, were cultivated with no special care, but the large nuts soon attracted attention. The *Parsons' Japan* was well known a few years ago, but at present no important varieties are cultivated from this importation.

In 1882, the late William Parry, Parry, N. J., imported one thousand grafted trees from Japan, and from them a single tree, the *Parry*, was finally selected, and has since become the progenitor of more valuable kinds than any other Japanese chestnut. The Parry Bros., who succeeded William Parry, have selected a large number of seedlings of the *Parry* for commercial propagation.

Luther Burbank, Santa Rosa, California, planted a box of the largest Japanese chestnuts sent him from his collector in Japan in 1886, and from over ten thousand bearing seedlings, after years of critical study and elimination, recently selected three as worthy of perpetuation—the Hale, the Coe, and the McFarland, now owned and propagated by J. H. Hale, South Glastonbury, Conn.

The Lovett Company, Little Silver, N. J., were active, at about the same time, in introducing the type through imported trees and nuts, and from the trees sent out by them, several meritorious kinds have been named by J. W. Kerr, Denton, Maryland, and J. W. Killen, Felton, Delaware.

A number of other firms have been introducing and distributing the nuts, but nearly all of the named varieties can be

traced to the introductions of the firms mentioned.

The varieties of Japanese chestnuts have been considerably confused through the unfortunate practice of some who have sent out seedlings under such names as "Japan Mammoth," "Japan Giant," and "Japan Sweet." These names, as generally used, have no varietal significance, for chestnut seedlings vary as widely as apple seedlings.

Geographical Adaptability

We can give no definite data that will establish the geographical limits of the cultivated chestnuts. Experimental effort is needed to establish their range of adaptability. It is not improbable that their distribution will follow the areas of the American chestnut, falling short of its extension in certain localities, and extending beyond it in others. As a guide to the possible geographical adaptability, the range of the American chestnut, adapted from Sudworth's "Check List of the Forest Trees of the United States," is given.

"From Southern Maine to Northwestern Vermont (Winooski river), Southern Ontario, and southern shores of Lake Ontario to Southeastern Michigan; southward to Delaware and Southeastern Indiana, and on the Allegheny mountains to Central Kentucky and Tennessee, Central Alabama, and Mississippi."

(Hardy varieties of chestnuts will do well along the Pacific coast as far northward as Washington, according to Mr. A. A Quarnberg, nut specialist, of Clarke county, Washington. The Japanese and French chestnuts shown in this article were grown by Mr. Quarnberg. Figs 2 and 3—Editor)

Uses of the Chestnut

Before chestnut culture can become a prominent industry, there will need to be a larger appreciation of the uses to which the chestnut can be put. Popular sentiment will also need revising, so that the chestnut harvest will not be looked upon as public property, purposely grown for the benefit of the community at large. The chestnut industry, as a means of enlarging the food supply of the United States, is a horticultural phase that is worthy of serious consideration. In many European countries the chestnut is looked upon as a staple article of diet.

In France

Griffin says, that in France, "from the Bay of Biscay to Switzerland, there are large plantations, and almost forests, of chestnut trees." The nuts "are broad, large, and resemble the American horse-chestnut or buckeye *(Esculus hippocastanum)*, and are extensively eaten by human beings and animals." * * * "The poor people during the fall and winter, often make two meals daily from chestnuts The ordinary way of cooking them is to remove the outside shell, blanch them, then a wet cloth is placed in an earthen pot, which is almost filled with raw chestnuts; they are covered with a second wet cloth and put on the fire to steam; they are eaten with salt or milk. Hot steamed chestnuts are carried around the city streets in baskets or pails; the majority of the working people, who usually have no fire in the morning, eat them for their first breakfast, with or without milk." * * * "These nuts are often used as a vegetable, and are exceedingly popular, being found on the table of the well-to-do and wealthy. They are served not only boiled, but roasted, steamed, pureed, and as dressings for poultry and meats."

"Chestnuts are made into bread by the mountain peasantry. After the nuts have been blanched, they are dried and ground. From this flour, a sweet, heavy, flat cake is made. It resembles the oaten cakes so popular among the peasants."

In Italy

In Italy, Bruhl says that the chestnut forms a considerable part of the diet of the people during the fall and winter, where they are generally eaten roasted. "They are also much eaten in a cooked state; often prepared like a stew, with gravy." He says, also, "the chestnuts are dried until they are as hard as dried peas, then shelled, after horses have been driven over them to crack the shells." The dried nuts can be shipped anywhere "and are said to be as good for cooking purposes as the fresh ones These are also sold on the streets and eaten like peanuts."

In Korea

In Korea, Allen says, "By far the most common food nut is the chestnut, which almost takes the place with the Korean which the potato occupies with us. The chestnut is used raw, boiled, roasted, cooked with meat, made into confections, powdered and mixed with candy, and dried whole, in which latter condition it becomes quite sweet, but is apt to be affected by worms."

In Japan

According to Rein great quantities of chestnuts are raised in Japan, but there they are used less for human food than they are elsewhere. They are fed largely to swine. The latter practice may account for the poorer quality of the Japanese chestnut; quantity, rather than quality, being the desideratum among the Japanese. Sargent, on the other hand, in referring to the human use of the chestnut in Japan, disagrees with Rein, and says, "I have never seen chestnuts offered in such quantities in any American or European city as in those of Tokyo, and other Japanese towns."

The composition of the European chestnuts has been shown by Frear to be similar to that of wheat. By the same writer and by others it is stated that the chestnut is easily digested after the starch grains have been burst open and made less resistant to the attacks of the digestive fluids, by cooking.

Botanical Considerations

The botanical rank of the chestnut groups is much perplexed. Botanists are unanimous in according the European chestnut specific rank, but the Japanese and the American types are considered both as varieties and as species by various authors. Personally, I prefer to consider the three groups as distinct species, for as they are growing in America, each has broadly differentiated characters on which to base specific rank.

Fig. 1. Types of Chestnut Foliage. (1) European at Left; (2) Japanese in Center; (3) American at Right. Note relative form, serrations, freedom of the Japanese only from leaf blight.

European Group

The European chestnut is a large, close-headed, but broadly spreading tree, with thick branches and large buds; oblong-lanceolate and generally abruptly-pointed, thick, leathery leaves, bearing small, sometimes incurved teeth, and generally pubescent beneath when young, and smooth and green on both sides when mature. The burs are enormously large, with a thick, felt-like, hairy lining; the nuts are thickly pubescent at the tip, and sometimes over considerable of the sides; variable in quality from bitter to sweet; with a long point. The trees retain the foliage late in the fall, and it is susceptible to the attacks of leaf fungi. (See Fig. 1.)

Fig. 2. Alpha Japanese. Chestnut Grown in Clarke county, Washington.
—*Maxted Photo.*

American Group

The American chestnut differs in a larger, freer, more upright form; more slender branches; larger, thinner, more pointed leaves, with larger, more spreading teeth, in a greater pubescence when young; smaller burs, and sweeter, smaller, more pubescent nuts. The foliage is also susceptible to leaf fungi, and is shed earlier in the fall. (See Fig. 1, 2.)

Japanese Group

The Japanese chestnut is a semi-dwarf, close-headed tree, with very slender, slow-growing wood, bearing small buds close together, and apparently, though not actually, opposite, on the smaller growth. The leaves are smaller than the American or European, quite like the peach-leaf in appearance, long, narrow, generally pointed, with narrow, truncate or cordate base, white tomentose beneath and pale or bright green above, teeth, small and sharply awn-pointed. The burs are comparatively small, with a thin, often parchment-like, hairy lining. The nuts large, comparatively free from pubescence, earlier to ripen, and poorer in quality, though excellent when cooked. The foliage of the Japanese is apparently free from the attacks of the common leaf fungi. The tree is a beautiful specimen for ornamental purposes. (See Fig. 1.)

The Blossoms

The chestnut is monecious, that is, the male and female flowers are separate on the same tree. Young, vigorous-growing trees frequently produce male flowers only, and after their excessive vegetative vigor ceases and the trees become older, the female flowers develop. The staminate flowers are borne in long, slender catkins, and are much more numerous than the pistillate flowers. The pistillate flowers are clustered at the base of a long catkin, on the distal end of which the staminate flowers open later in the season, the catkin aborting down to the little female blossoms.

The pistillate flowers are probably fertilized by both sets of staminate blossoms, the early ones fertilizing the early opening blossoms, and the later ones furnishing the pollen for those that are retarded. Thomas Meehan tells me that he thinks the pollen from the late staminate blossoms performs the function of fertilization, and that the great show of staminate catkins is a waste of energy, in the American chestnut. In both European and Japanese varieties, I have noticed that most of the pistils are receptive while the early staminate flowers are in bloom.

Suggestive Hints on Chestnut Culture
The Production of Varieties

Seedlings. The large varieties of cultivated, foreign chestnuts have been

evolved from the wild types through centuries of selecting slightly better seedlings in each successive generation. Chestnut seedlings exhibit variations from the smallest American nuts to the largest Japanese, from enormous productiveness to approximate sterility, from an acorn-like flavor to a sweet, desirable quality, from ripening in August to maturity in October. Some of the seedlings hold their dead leaves all winter, others have nuts enclosed in a bur from which it is difficult to extract them. Certain varieties, like the *Parry*, are extremely prepotent, and their progeny exhibit striking similarities. From the desirable variations new kinds can be produced.

Crosses

New kinds may be produced by crossing the varieties within the species, or the Japanese, European, and American varieties may be intercrossed. Mr. Luther Burbank informs me that he has a few hundred hybrid chestnuts just beginning to bear—crosses of Japanese, European, Chinese, chinquapin, and others, among which are a number of extremely valuable varieties. Mr. Burbank thinks that *all* the chestnuts intercross as readily as the various varieties of apples.

Bud Varieties

New varieties may possibly be developed from bud variations, as tree under apparently similar conditions, show the widest differences in bearing tendencies. The variations might be perpetuated in newly grafted trees, though it is quite possible that the violent differences within the cultivated varieties are due to the reciprocal action of stock and scion, when the union is imperfect. At any rate, in the perpetuation of a variety, too much care cannot be used in selecting scions for propagation only from trees with desirable bearing tendencies.

Propagation

Grafting. Chestnuts are propagated usually by grafting, though budding, with buds that have been held dormant, is frequently practiced in the spring in the South. The scions are inserted upon the stocks by different propagators in four positions, *i. e.*, in the root, in the crown, in the body or stem, and in the top or branches of the tree. Two methods of grafting are generally employed, the cleft graft for stocks of large size, and the whip-graft for smaller stocks. A third system, the bark graft, is occasionally used for very large stocks. The grafting technique must be performed most skillfully to insure a successful outcome. The scions should be cut with precission, and the young, fine wood, especially in the Japanese varieties, should be discarded. Immediately after inserting the scions, the stubs must be carefully covered with wax, or with waxed cloth, the latter method being preferable for young trees, as the stubs often do not close tightly. If the stub can be cut two or three inches above a fork, the openings close more firmly.

Britton, of the Connecticut station, in 1898, found from grafting over two hundred scions of the Japanese and European varieties on American stocks, that more scions live when inserted after the leaves had begun to expand.

He says that the early grafts that survived made a much larger growth than the later ones. He states also that the scions take more readily in young shoots.

Stocks for Grafting in the Nursery

The cultivated varieties of the European chestnut are generally propagated, either upon their own American-grown seedlings, or upon native, American seedlings Japanese varieties are often propagated upon seedlings grown from imported Japanese seed. Occasionally, seedling trees of the European chestnut are imported, but they are worthless for propagating purposes as the bodies become afflicted with sun scald.

Each species seems to work best upon stocks of the same type, but there is a close affinity between the Japanese and the American stocks, and between some varieties of the Europeans and the American seedlings.

The European varieties are propagated largely upon American stocks, and successfully with many varieties, but nur-

serymen are coming to use seedlings of the European varieties in preference. The European scions sometimes outgrow the American stubs, making an enlarged, or a poorly united union, the scion frequently blowing out during the first season of growth.

The Chestnut Orchard

The chestnut orchard should be located on a well drained, porous soil, with a deep, porous subsoil, through which the roots can descend and supply the tree with moisture in drying weather It is more important to have thoroughly drained soil than soil of a particular character, and the trees will then flourish on light sands or heavy clays. Limestone lands are generally uncongenial to the chestnut, due probably to the close proximity of the underlying rocks to the surface, for in limestone soils with well-drained, deep, porous subsoils, the chestnut thrives heartily.

The European chestnut should be set not less than forty feet, and the Japanese not less than thirty feet apart each way. The trees can be planted much closer at first and cut out to those permanent distances ten or fifteen years later after several profitable crops have been removed. The care of the young orchard should be the same as that given a young apple plantation.

Subsequent Care of the Trees

Grafted chestnut trees are precocious. The grafts of the Japanese sorts on sprout land frequently set fruit the same year of insertion, and their early bearing tendencies often prevent a satisfactory development of the tree. Two-year-old grafts are commonly loaded with burs in both Japanese and European kinds, though the Japanese varieties as a class bear earlier, both when grafted and from seed It would probably be a profitable undertaking to keep the burs picked from the young trees for three or four years, in order that they might become strong and thoroughly established before the strain of reproduction is upon them. The young trees should also be pruned to an open spreading form, with three to five main branches on which the top will eventually form, after which the trees themselves will need little care other than good culture. If the trees are allowed to over-bear, the nuts run down in size.

Do Varieties Need Cross Fertilizing

The question cannot be answered satisfactorily with our present knowledge. Nearly all of the European varieties abort a large proportion of their burs when the latter are partly grown, the Paragon and Comfort being freer from it than any of the other kinds. I have seen instances of European trees that are non-productive at ten years old when standing alone, but whether they would be more productive in proximity to other varieties is an open question. The Japanese varieties do not abort their burs, and seem to be completely self-fertile. In the absence of definite information, we would advise mixed planting as a safeguard.

Prices of Nuts

During the years 1896 to 1898 prices of various varieties of chestnuts sold all the way from $4.00 to $14.00 per bushel.

The earliest and the biggest chestnut commands the highest price. Earliness is the more important factor. Quality, at present, is not considered by the purchaser, the crop selling largely from the street stands to boys and girls. The nuts should be carefully graded into two or three sizes before shipping and the wormy ones destroyed, as the price of a mixed lot is regulated by the smallest nuts. The chestnuts are shipped in bags, or in crates holding a number of small baskets. The burs and nuts are gathered every few days, and the burs that do not cast their nuts are torn open by an operator wearing leather mittens.

European or Japanese Varieties

One of the first considerations to confront the prospective commercial chestnut grower is, "Shall the European or the Japanese varieties be planted, or both?" The question is a difficult one to discuss without awakening enmity, for both species have equally earnest advocates. The writer, however, will at-

Fig. 3. French (1), and Japanese (2), Chestnuts Grown by Mr. A. A. Quarnberg at Vancouver, Washington.

tempt to place their merits side by side as impartially as possible, basing the estimate not on a limited observation of a few trees, but on an acquaintance with both species growing together on a large commercial scale.

Japanese Group

Advantages

1. Early maturity of tree.
2. Ease of caring for trees.
3. Early ripening of nuts.
4. Large size of nuts.
5. Enormous productiveness.
6. Small size of bur.
7. Freedom from leaf blight.
8. Freer from worms than Europeans.
9. The money makers in the large groves.
10. Affinity for American stocks.
11. Ornamental value.

Disadvantages

1. Overbearing, if not thinned.
2. Poorer quality of many.
3. Delicate growth of some.

European Group

Advantages

1. Great productiveness of some.
2. Timber value of tree.
3. Finer quality.
4. Beautiful appearance of nuts of some.
5. Prolific bearing of a few.

Disadvantages

1. Late maturity of many.
2. Late ripening of nuts.
3. Shy bearing of many when young.
4. Largeness of bur, which may become watersoaked and break the trees.
5. Great susceptibility to leaf blight.
6. Greater susceptibiltiy to weevil.
7. Do not compare with Japanese in the commercial groves as money makers.

It can be stated as a general principle, that the Japanese flora is better fitted to the climatic conditions of the Eastern United States than the flora of Western Europe, the latter succeeding best on the Pacific coast. Hence it is thought that if the Japanese species is used as a basis for further improvement, happier results will eventually follow its amelioration in the Eastern United States. The Japanese or European varieties, as they exist, should be looked upon only as stepping-stones to better kinds. By the continued judicious selection of seedlings from varieties of the best flavor, the quality of the Japanese chestnut can be greatly improved in a few generations. Some of the finer quality of the chinquapin or of the native chestnut might be infused into the Japanese with happy results, and a more vigorous tree would follow the incorporation of a little European blood. One type should supplement the other whereever the adaptability of both is proven.

Estimate of Varieties

The varieties of the cultivated chestnuts are not well enough established, nor have they been grown on a sufficiently comprehensive scale to determine their horticultural value. Some of the most promising kinds are confined to a few trees only. It is therefore impossible, to compare the various kinds, justly, but the reader would probably not be satisfied unless some expression of preference was recorded. Nothing more than a personal preference can be expressed, and the following varieties include those that the writer would plant on his own place for commercial purposes. The first list is based upon the behavior of the varieties that are growing on an extensive scale, the second list includes those kinds which are promising, but which have not been grown extensively.

Varieties Grown Extensively

Japanese—Alpha, Reliance, Parry. First choice.

European — Paragon. First choice. Numbo. Second choice.

Varieties Not in Large Blocks, but Promising

Japanese—Kerr, Kent, Killen. First choice. Biddle, Felton, Martin. Second choice.

European—Ridgely, Scott, Styer. First choice. Dager, Darlington. Second choice.

The Hale, McFarland, and Coe are highly spoken of, but the writer has never seen specimens and is therefore unable to give them a fair estimate.

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CHESTNUT DISEASES

Anthracnose

Marsonia ochroleuca B. & C.

Is a disfiguring spotting of chestnut leaves. Small, dead areas with characteristic borders are produced by this fungus. Such applications of fungicides as are made for shot hole fungus of the plum and leaf spot of the horse chestnut, will be found useful when treatment becomes necessary on the chestnut.

(Japanese varieties are immune to this trouble.—Ed.)

A. D. Selby,
Wooster, Ohio.

Body Blight

The trunks of the chestnut trees in the nursery frequently blight upon the south and west sides. The bark splits or sinks in and the affected tree finally dies. Larger Japanese seedling trees, eight to ten years old, are sometimes affected in the same manner, but I have not observed the difficulty on the larger Europeans. Imported European seedling trees seem to be more susceptible than any others, and American seedling stocks are affected to a lesser extent. Fig. 1 shows sections of the trunk affected with the body blight. The sections were taken from trees in a lot of one thousand imported European seedlings, nine hundred and fifty of which died soon after setting out. As the malady nearly always appears on the south and west sides

Fig. 1. Sun Scald or Body Blight.

of the tree, it is thought that the trouble is not unlike the *Sun Scald* of cherry and other young fruit trees.

G. Harold Powell

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Canker. See *Bark Disease*, this section.

Chestnut Bark Disease

Diaporthe parasitica Murrill

This disease occurs in the northeastern part of the United States and threatens great damage to chestnut trees of all species except certain Japanese varieties which seem to be immune. The flavor of these seems to be inferior to that of the improved European sorts but is believed that varieties can be developed by crossing which will combine the flavor of the European and the resistant qualities of the Japanese varieties.

The disease girdles the twigs and affected limbs and otherwise reduces the vitality of the tree. The fungus confines itself to the bark and cambium and seems to gain entrance almost wholly through wounds.

No satisfactory method of control has been discovered except that of severe cutting when the disease first appears on branches and twigs.

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Chestnut Blight. See *Chestnut Bark Disease*, this section.

Crown Gall. See under *Apple Diseases*.

CHESTNUT PESTS

Chestnut Weevils

According to Chittenden* there are two species of chestnut weevil, the "larger" and the "lesser."

They have extremely long, slender beaks or snouts, nearly as fine as a horsehair, and considerably longer than the body in the female. By means of this long beak the female is able to penetrate the thickest bur of the chestnut with its long spines and to cut out, with the minute and sharp mandibles at the tip of her beak, a little hole for the deposition of her eggs. These are inserted through the husk into the growing nut.

The two species resemble each other greatly in color and in markings, the general color of both being golden yellow, ochraceous, or clay yellow, frequently tinged with olive, and a little paler on the lower surface. The disk of the thorax is a little darker with a wide bright band on each side, and the elytra, or wing covers, are mottled with rich light brown or dark brown markings of variable size and extent.

Larger Chestnut Weevil

Balaninus proboscideus Fab.

The larger chestnut weevil is considerably the larger and more robust species. The female rostrum or beak, although proportionately of about the same length as in the lesser weevil, is perceptibly more prominent because less curved, the curvature being toward the tip. It is also more widened at the base. The body measures from one-third to nearly one-half of an inch in length, and the beak of the female is often five-eighths of an inch long.

The larvae is milk-white, robust, fully three times as long as wide. The fully developed larva in ordinary resting position measures nearly half an inch. Although the larvae has no true legs, it is able to crawl, slowly and clumsily, it is true, by means of the flattened lower surface, locomotion being aided by transverse wrinkles.

The pupa is of a clearer whitish color than the larva, and shows the principal external organs of the body of the future beetle, all, except the beak, folded tightly to the body.

This species, like the other weevils under consideration, is native to America and is known from Rhode Island to Virginia, the District of Columbia, southern Ohio, and Tennessee, and westward to Kansas. The geographical distribution of this and the other nut weevils has as yet not been carefully studied, but

* Bureau of Entomology Circular No. 99.

in all probability it is considerably more extensive than above stated.

Lesser Chestnut Weevil

Balaninus rectus Say.

The lesser chestnut weevil has the scape of the antenna longer than in the preceding species and the first joint longer than the second. The average length of the body is about one-fourth of an inch, but the size varies, as in all of these insects.

The distribution of this species extends from Canada and Massachusetts to North Carolina, Tennessee, and Ohio, and probably farther westward.

The larvae is only a third of an inch long and its length is about three times its width. The body is milk-white and the head light brownish yellow.

Life History of Both Species

The life history is similar for both species. These, as well as related nut and acorn weevils, hibernate in the larval condition and in the soil. Both make their appearance with the first blooming of chestnuts. The beetles increase in number as the nuts approach maturity, or until about the middle of September or a little time before the nuts are first marketed. Then they may be seen in greater abundance, several pairs, frequently of both species, often occurring on a single bunch of burs. From examination of many burs it is deduced that the first eggs deposited are laid (seldom and very sparingly) in the soft, woolly material surrounding the forming nut; but later they are inserted in the kernel just under the inner skin, and occasionally they are deposited somewhat more deeply. In no case has the egg been found in the outer husk.

Eggs are laid singly, but many are placed in a single nut, as high as 40 or more (of the smaller weevil) in imported nuts, and as many as 9 in native nuts.

By the end of September or the first week of October the beetles disappear. At about the same time, when the nuts first fall, the larvae begin to mature and issue from round orifices which they gnaw through the shell.

On leaving the nuts they burrow into the earth to depths varying from 2 to about 8 inches, according to the hardness of the soil. The larval period probably lasts from three to five weeks in the nuts, and about ten months in the earth.

The beetles do not fly readily, but cling tightly to their resting place or drop when disturbed; yet, as their bodies are not heavy and their wings strong, they are obviously able to cover considerable distances especialy with the wind. Ordinarily, however, they are sluggish, like most other weevils, and probably do not go far from the vicinity of the trees which have sheltered them as larvae, although they undoubtedly migrate when food is scarce.

Natural Enemies

A natural enemy of the nut weevils is known, a small four-winged wasplike fly, the braconid parasite *Urosigalphus armatus* Ashm., which develops in the body of the larva.

Methods of Control

The most practical remedy for nut weevils that can be suggested is the early destruction of the "worms" in the nuts by means of bisulphid of carbon and the observance of clean orchard management and other cultural methods.

The Water Test of Infestation

Having doubts of the efficacy of this old-fashioned test of the difference between "wormy" and healthy nuts, an experiment was made by the writer with native chestnuts obtained from a street vender. To begin, 40 per cent were obviously "wormy," and only 60 per cent apparently sound.

Results of Water Tests with Native Chestnuts

NUTS WHICH ROSE TO SURFACE

	Per Cent
Uninfested	10
Showing minute marks only; good flavor; salable	20
Containing full-grown grubs	10
Containing immature grubs	60

NUTS WHICH REMAINED ON BOTTOM

	Per Cent
In perfect condition	40
Slightly injured	30
Badly infested	20
Completely filled with grubs	10

As will be seen from this experiment, noticeably wormy nuts, as evidenced by

loss of weight, and the exit holes of the "worms," naturally rise when placed in water, but the remaining nuts may or may not be infested, and hence require further test than whether they will sink or float

Direct Remedies

Bisulphid of Carbon

The value of bisulphid of carbon as a fumigant for chestnuts infested by weevils is now fully established. The dead weevil larvae are at this time so small that the average person would never detect their presence, while if they were permitted to develop they would soon destroy the nut for food.

The following treatment is recommended· ½ ounce of bisulphid of carbon to one bushel of nuts placed in a kerosene barrel of 50 gallons capacity, tightly covered and left for two days.

Scalding and Drying

Some growers make a practice of plunging the nuts as gathered into boiling water just long enough to kill the contained insects and yet not injure the nuts for sale, after which they are dried before being marketed. This may be profitably accomplished by using a large sieve, which is filled with nuts, dipped in the water, and removed in about five minutes. Salt water, it is claimed, is preferable for scalding, the brine serving to keep the shell soft and pliable and rendering the kernels more palatable than when not thus treated.

Nuts for planting should not be scalded, and care should be taken not to cook the kernels of nuts intended for sale

Heat

Infested nuts can be subjected to a temperature of between 125 degrees Fahrenheit and 150 degrees Fahrenheit without injuring them for food or for seed and this will effect the destruction of the larvae within. Some growers of chestnuts destroy the weevils by kiln-drying.

Cold storage has been employed and this is successful in arresting the development of the larvae, but nuts thus treated were deficient in flavor.

Preventives

Choice of Location for the Orchard

It is most undesirable to plant in the immediate vicinity of woodland abounding in wild chestnut and chinquapin, since these trees furnish natural breeding places for the insects, and are, therefore, a constant menace to successful chestnut culture.

Wild chestnuts or chinquapins in the immediate vicinity of cultivated groves should be gathered. To secure good results, it is imperative to plant or graft trees on smooth ground, first for the sake of economy, and second to permit the collection of all of the nuts, leaving none for the propagation of weevils.

Two-Lined Chestnut Borer

Agrilus bilineatus Weber

Occasional outbreaks of this insect have been reported when they have done considerable damage

The beetle is elongate, black with a more or less greenish tinge, about three-eighths of an inch long.

The larva works just under the bark of the tree making galleries which results in a practical girdling.

The most important requisite in controlling the borer is clean culture. All dead wood should be cut out and burned. Cut and sawed timber should have the bark removed.

For shade trees some mechanical protection during the egg-laying season is practicable.

Sprays of lime and Paris green are deterrents, also fish oil and petroleum preparations.

Reference

Bureau of Entomology Circular No. 24, Revised.

Cider Products Made on the Farm

There are but few orchardists whose apples are of so uniformly good quality that there is not quite a percentage that will have to be disposed of in some way other than shipping to market. One of the best ways of disposing of this fruit is the making of it into vinegar. The

New York Experiment Station recommends the following as one of the most satisfactory methods of making vinegar:

When cider is pressed from the apples the barrels should be filled about two-thirds full and the bung replaced by a loose plug of cotton, which will lessen evaporation and keep out bugs and dirt. When the quantity of vinegar to be made is considerable the barrels should be placed in a room where the temperature can be kept at from 70 degrees to 80 degrees during the fall and early winter months. If the batch is small the barrels may be left out of doors while the weather is warm and then placed in the warmest room convenient and later in a dry cellar. If the temperature of the storeroom does not fall below 45 degrees the conversion of the sugar into alcohol will require about six months, but the process of fermentation may be hastened by the addition of fresh commercial yeast. When the cider quits working the clear portion should be drawn off, the barrel rinsed out and the liquid replaced, with the addition of from two to four quarts of good vinegar containing some mother.

The next process, the change of the alcohol into acetic acid, may be effected in three months, and may require two years. In any event, it will take place most rapidly in a temperature ranging from 65 degrees to 75 degrees

When the vinegar has reached the per cent of acetic acid, the barrels should be filled full and tightly corked. This will prevent other changes and will cause the vinegar to keep its strength.

Cider Apple Butter

Takes about one gallon of apples, peeled, cored and quartered, for three gallons of cider. But apples differ. When using sweet russets for thickening, it only takes about eight gallons of apples to thirty of cider. In hot weather, cider should be boiled down to one-third, the same day it is made, then left in stone jars until morning. In cool weather it may be left in barrel in shade until next day. Run cider out of barrel and strain through a poke made of towel Boil in copper kettle, freshly scoured with salt and vinegar. Kettle must not stand after being scoured, but fire and cider must be all ready for it. Cider must not stand in kettle without boiling, or it will have a bitter taste and be poisonous. Put apples all in cider at once, after it is boiled down, but save out some cider to fill in with and to keep it from boiling over. Apples will rise in kettle as they boil to cook, but will soon go down again. It will take about four hours' constant cooking and stirring to make it so it will keep throughout the next summer. When done dip out into stone jars. Next day heat jars in oven of cook stove, tie up and put away. Skim cider while boiling.

Never allow a chunk or stick to touch kettle, or your butter will scorch. Turn kettles upside down on grass. Clean next morning while grass is wet. If you do not make your butter so thick, put it in jars with stone lids and seal same as fruit. If cider stands all night after it is boiled, let it get hot before putting in apples, and scour kettle before beginning again.

Apple Butter

Take eight gallons of cider, boil two hours, add ten gallons of ground apples, cook until done in a brass kettle, and add 16 pounds of sugar, either soft white or granulated. When done the apple butter may be flavored by adding cinnamon. This amount makes eight gallons of apple butter.

Tomato Butter

To two gallons of cooked apples and two gallons of tomatoes, cooked and pressed through colander, four sliced lemons, add sugar until as sweet as desired, flavor with cinnamon, cook until it thickens and then can.

Peach Butter

Pare, stone and cook peaches until tender, then press through colander. Measure out as much sugar as peaches, after they are cooked. Add one-half of the sugar and cook one-half hour, then add the rest of the sugar and cook from one hour to one and one-half hours, or until thick; then can.

Pear Butter

Pare, core and quarter pears, cook until tender, then press them through a colander, add three-fourths of a pound of sugar to every pound of pears, cook until thick; then can.

Grape Butter

Pare, core and quarter as many apples as you have grapes, cook until tender, press through colander, cook grapes a few minutes, run through sieve. To four quarts of grapes add three quarts of apples and four pounds of sugar. Cook until thick; then seal.

Plum Butter

Cook plums until tender, press through colander, make the butter same as peach butter.

In making pear, peach and plum butter and in preparing apples for grape butter, enough water should be added in cooking them to cover.

Lemon Butter

Two cupfuls of sugar, juice of two lemons, two eggs, one lump butter size of an egg; mix all together and cook in double boiler, stirring all the time until it thickens. This is excellent for breakfast with hot biscuits and butter.

Use Ripe Fruit

The first requirement for good vinegar is to have the ripe fruit. Good apples under hydraulic pressure will give about four and one-half gallons of cider to the bushel. Pears under the same pressure will give more. Every utensil used in the work should be strictly free from must or mold. Hence they should be scalded in very hot water to destroy all germs. After having secured the cider it must be exposed at all times to the air, and the depth of the liquid should be no greater than the surface measure of the vessel holding it. A barrel should not be more than half full during fermentation.

The temperature should be even and rather warm. Temperature determines the time in which the fermentation is accomplished. Eighty degrees gives quickest results; with this heat good vinegar can be had for use in four months, in which time it should show 6 per cent acetic acid. The ordinary time is six months, with only ordinary temperature. By close attention to these particulars a good healthful vinegar can be cheaply made, which will command from 14 to 20 cents per gallon in the market.

Well ripened fruit should be used, as it contains the greatest amount of sugar, which aids in yielding the highest per cent of acetic acid. Under no circumstances use decayed fruit for healthful vinegar. A small yeast cake dissolved in some of the cider and then poured in the barrel will set fermentation going at once. Do not stop the fermentation, but let it complete its work. When fermentation ceases, procure some mother of vinegar and put in barrel. If this cannot be had, get some pure sharp vinegar and pour this in the barrel. When completed fill barrel full and cork securely to prevent any undesirable ferments afterwards.

Pear Vinegar

Pear vinegar requires some longer time than apple cider, and will show 8 per cent acetic acid, making it sufficiently strong to be afterward diluted one-half. Vinegar can be made from the small fruits, especially the blackberry, but it is more expensive and the color is not favorable.

Fruit Butter

For fruit butter the cider or juices and the filling should be boiled in separate vessels, to hasten the work and give better appearance to the product. Any sweetening used should not be added until the butters are about ready for removal from the fire. Fruit for the filling should be quite ripe, and it then has all its flavors and is more readily cooked. After the juices are sufficiently boiled down the filling may be added and the boiling continued till it presents appearances of being sufficiently thick, when the sugar may be added such as the nature of the fruit requires. By withholding the sugars till at this state, you prevent danger of scorching, have a better color to the butters and a better re-

tention of the fruit flavors than can be had by adding the sugar at once.

Care must be used to prevent any settling of the filling while boiling, for this will result in scorched butters. Never use spices of any kind for flavoring, as these destroy the natural flavors of the fruits used and cause the butters to become strong in time; also, they give the butter a dark, uninviting appearance.

Juices of one kind of fruit used with filling of another make a very inviting butter. As for instance, pear cider with apples for thickening, or any combination one may like. After butters are cold, if one adds to the surface a few spoonfuls of brandy it will prevent any mold from forming at all. Kept in a cool, dry room, butters thus made will grow better with age.

Other Recipes

To make apple butter, take a half barrel of good, fresh cider and boil down one-half, then add three bushels of good cooking apples that have been pared and quartered. We have made small quantities at a time in a porcelain kettle on the kitchen stove, but if one can procure a large copper kettle, it is best to make it out of doors, using the long handled stirrer. When the apples begin to cook up, the mixture should be constantly stirred until done, when it should be smooth and thick. Just before taking off add ten pounds of sugar. If sweet apples are used for both cider and filling, the sugar may be omitted. If the apples are not of good cooking kind, they can be ground up in a meat grinder, which will hasten the cooking process. If this apple butter is cooked quite thick, it will keep without sealing.

Very nice peach butter can be made by boiling down the cider the same as for apple butter and filling in with peaches. Pear butter is made the same way, using ripe pears for filling.

To make grape butter, put grapes on to cook, with water enough to cover, boil an hour or more, pour while hot over a sieve. Measure the juice that drains through and put on stove to boil again. Press the remainder of grapes through sieve to remove skins and seeds. After the juice has boiled down one-half, add half as much sugar as the measured juice, and add the pulp that has been pressed through the sieve or colander. It will need to be stirred only a short time. This is to be sealed in either glass cans or stone jars.

Tomato butter is made in the same way as grape butter, except that the juice should be boiled until nearly thick before adding the tomato pulp.

A butter made of equal parts of plums and pears is superior to that made of either fruit alone.

Cook each fruit in water separately, then put plums through a sieve and add the pears. Use sugar to make sweet enough after the mixture has boiled thick and smooth.

Citrange

The citrange, which is a cross between the worthless Trifoliate orange of Japan and our ordinary sweet orange, is not an orange, but a hardy substitute for the lemon. The fruits are very juicy, containing a larger amount of juice proportionately than the best lemons. They make a refreshing "citrangeade," similar to lemonade, which people who have made a comparison pronounce equal to or even better than the latter. The fruits also make excellent pies and marmalade, and for these purposes are probably equal to the orange and the lemon. The citrange will undoubtedly prove valuable for general culinary purposes in the making and flavoring of cakes, making jellies and preserves, and in many other ways in which the lemon is now employed. When it is considered that these citranges can be grown throughout a large part of New Mexico, Utah, Nevada, Oregon, and Washington, where there is now a dearth of acid fruits their great value becomes evident.

There is at present, however, no market for the citrange, and it will probably prove of value mainly as a home fruit for cultivation throughout the regions mentioned, where the sweet orange, the lemon,

and the lime can not be grown. The trees are attractive in shape and semi-evergreen, so that they will make desirable lawn trees. Wherever a home can be supplied with them it will be possible on the warm days between the 1st of September and the 1st of December to pick a few fruits and make a desirable and refreshing beverage.

Through the senators of the Pacific coast states, arrangements have been made with a few leading fruit growers to give trees of this variety a trial test. A number of young trees have been distributed by the Plant Bureau, U. S. Department of Agriculture for the purpose.

Citrons

There are two species of citron. One is the species *Citrus Medica* of the same genus as the orange, lime and shaddock or pomelo. The tree is an evergreen shrub growing to a height of about 10 feet; has irregular straggling spiny branches, large pale green broadly oblong, protuberant at the tips and from five to six inches long, with a rough adherent rind, the inner portion of which is thick, white and fleshy, the outer, thin, greenish yellow and very fragrant. The pulp is sub-acid, edible, much less acid than the lemon and the seeds bitter. There are many varieties of the fruit, some of them of great weight and size. The Madras citron has the form of an oblate sphere; and in the "fingered citron," of China the lobes are separated into finger-like divisions formed by separation of the constituent carpels, as occurs sometimes in the orange.

The citron tree thrives in the open air in China, Persia, West Indies, Madeira, Sicily, Corsica, in the warmer parts of Spain and Italy and the American continent.

The rind of this species of citron yields two perfumes, the *oil of cedra*, and the *oil of citron*, with the ultimate composition of an isomeric with the oil of turpentine. When candied, it is much esteemed in dessert and in confectionery.

The other species of citron is a variety of watermelon, nearly solid, almost flavorless, growing on a vine that resembles the watermelon vine, the fruit of which is made into preserves, resembling the real citron.

For CULTURE. See *Watermelon*.

The first species named is not grown largely in the United States, but is grown with some degree of success and recommended by American Pomological Society as follows, for kitchen purposes:

Lemon, Lyman and Orange in Florida and the southern portions of the Gulf States.

For DISEASES AND PESTS OF CITRON OF THE TREE VARIETY, see under *Lemon and Orange*.

For the VINE CITRON, see under *Watermelon and other cucurbitous crops*, as; *Cucumber*, *Cantaloup*, *Squash*, *etc*.

Citrus Fruits

This subject is treated under the respective fruits, as follows:

Citrons, Kumquats, Lemons, Limes, Oranges, Pomelos or Grape Fruit, Tangerines.

Citrus Fruits—Trees, Production and Value
1910 Census

State—	1910 Trees of bearing age	1910 Trees not of bearing age	1909 Production (boxes)	1909 Value	1899 Production (boxes)
All citrus fruits *..	11,486,768	5,400,402	†23,502,122	$22,711,448	7,098,486
Oranges, total	9,737,927	4,327,271	19,487,481	17,566,464	6,167,891
Arizona	33,373	56,982	32,247	52,341	11,116
California	6,615,805	2,093,410	14,436,180	12,951,505	5,882,193
Florida	2,766,618	1,097,896	4,852,967	4,304,987	273,295
Louisiana	266,116	155,016	149,979	222,339	1,285
Mississippi	10,452	38,637	3,779	8,648	......
Texas	42,384	867,407	10,694	22,090	......
Lemons, total	956,920	396,111	2,770,313	2,993,738	876,876
California	941,293	379,676	2,756,221	2,976,571	874,305
Florida	11,740	7,329	12,367	13,753	2,359
Pomeloes (grape fruit), total	710,040	640,597	1,189,250	2,060,610	30,790
California	43,424	25,589	122,515	143,180	17,851
Florida	656,213	600,049	1,061,537	1,907,816	12,306
Limes, total	45,387	30,239	11,318	12,478	22,839
Florida	45,369	30,088	11,302	12,457	22,714
Tangerines, total	27,271	3,873	38,752	68,770	(‡)
California	3,637	34	3,581	4,188	......
Florida	23,234	3,839	34,871	64,082	......
Mandarins, total	7,227	1,923	3,896	6,553	(‡)
Louisiana	6,875	1,900	3,340	5,945	
Kumquats, total	1,988	358	1,112	2,826	(‡)
Florida	1,955	222	1,091	2,768	......

* Includes a small number of citron trees in 1910 and the value of their product in 1909, also a small amount of product in 1899.
† Exclusive of a small quantity of citrons.
‡ No report.

CLEAN TILLAGE. See *Apple Orchard, Cultivation of.*

CLIMATE. See *Selecting Site for Apple Orchard.*

Climatic Conditions as Affecting Certain Crops

It seems to be a provision of nature that everything cannot be successfully grown everywhere. The wisdom with which we decide upon the adaptability of crops to climatic conditions will determine in a large measure the degree of success resulting from our labor. It would be folly to try to grow oranges for commercial purposes in Colorado, Montana and Washington. It would be equally unwise to try to grow winter apples in the regions best adapted to the orange. In like manner, but not so marked, there are adaptations of fruits to interior and coast climates. For instance, the climate of Puget Sound in the state of Washington, as contrasted with the interior and eastern portions of the same state. On the west side of the Cascade range, irrigation is seldom practiced, while on the east side, there are sections where nothing could be grown without irrigation. On the west side, the rainy season is in autumn, winter and spring, followed by a dry season in which certain kinds of crops suffer for lack of moisture. On the east side, by the process of irrigation, moisture is present wherever the farmer chooses to apply it.

The result is that on the west side all kinds of fruits of the early maturing varieties may be produced. Strawberries, blackberries, raspberries, prunes, early pears, cherries and such like fruits are grown as well on the west side as on the east side, with less labor and cheaper land. Granting, therefore, that on the east side as good berries, prunes and pears, could be grown, it would not seem wise to do so in competition with the west side where they can be produced with less labor. In the irrigated district, it might be found profitable to supply the local markets, but not to ship to the general markets. An exception might be the case of crops which mature earlier in the dry section and so secure the higher prices obtained for the early fruits, as for example, the Kennewick strawberries, which arrive in the market ten days to two weeks before the berries from the coast section. On the other hand, the east side can produce apples and peaches and perhaps other varieties of pears, better than they can be produced on the west side. They have

their dry season at a time when the apple needs moisture to make its fullest development.

Second, it needs the bright sunshine to give it color at a period when, on the west side, there is the beginning of the rainy season.

Third, in the humid climate, fruits are more subject to fungus diseases, than in the arid climates. It is not contended by fruit growers on the west side, that they can successfully compete with the east side in the growing of apples, but they do contend that they can compete successfully in strawberries, other small fruits, prunes and pears. Our observation leads us to conclude that their claim is just, except as noted in the case of the earlier markets. I have not seen strawberries as have been grown in the Vashon Island and other Sound districts nor better cherries than those grown in the Willamette valley, Oregon, nor better raspberries and blackberries than grow in the Puyallup valley. As for the growing of pears, I have seen them as well developed, and to all general appearances, as good as those grown on the east side. It would seem, therefore, that the growing of certain fruits, should be localized into those sections where they will produce the most money with the least expenditure of labor.

GRANVILLE LOWTHER

CLOVERS. See *Apple Orchard Cover Crop.*

CLOVER APHIS ON APPLE. See *Aphids.*

DISEASES AND PESTS OF CLOVER AND ALFALFA

Clovers, alfalfa and other similar field crops are treated in this work only in connection with the orchard. A brief section covering some of the principal diseases and insect pests of these crops is here given.—Ed.

DISEASES

Anthracnose

Three anthracnoses occur upon clover; the more common of which is due to the same fungus *(Colletocrichum trifolii* B. & E.) as the anthracnose of alfalfa. These show lesions of the stems and leaf stalks and may be detected in the new seedlings in late summer through the dying of the leaves of these plants. It is not known how serious this may prove upon clover.

The second anthracnose fungus *(Gloeosporium trifolii* Peck.) has been known longer than the first and occasionally shows by killing the tops of large clover stems in meadows. It is apparently not a serious disease, although a very interesting one to study in connection with the anthracnoses due to *Colletotrichum.*

The third anthracnose upon clover *(Colletotrichum cereale* Manns.) is the anthracnose of wheat, rye and oats.

Two new anthracnoses have been discovered attacking alfalfa; the first of these, *Colletotrichum trifolii* B. & E., so far as we know occurring exclusively on plants of this family, the other, *Colletotrichum* sp., occurring only on alfalfa in northern Ohio. The first one, which we may call clover anthracnose, was discovered in Tennessee and has appeared upon alfalfa as well as red clover in the southern portion of Ohio and in Arkansas. It is less prevalent on alfalfa than upon the red clover. Both of these diseases show as a specific lesion or diseased spot on the stem or leaf stalk in the advanced stages of attack. Following this the plants wilt or die and are discovered in this way.

Bacterial Blight (Yellowing)

A bacterial blight of alfalfa, of which the causal organism has not been definitely determined, has been reported from Colorado where it appears to be spreading. In 1907 and to a still greater extent in 1908, there was much complaint of general yellowing of leaves of second crop alfalfa in Ohio and adjoining states, even extending to North Carolina. The symptoms are general yellowing of this crop.

Black Spot

Phyllachora trilfolii (Pers.) Fckl.

Is due to a fungus which attacks the leaves of clover causing dead spots and dark discolorations on the under side of the leaves. As a rule these attacks come so late in the working life of the leaves that the injury is slight.

A. D. SELBY,
Wooster, Ohio.

Crown Gall

Urophlyctis Alfalfae

H. S. JACKSON

This is a comparatively new disease in North America. It was first observed in this country in California in 1909, and has since been found elsewhere only in Arizona and Oregon. This disease was first called to the attention of the writer in May, 1911, when specimens of alfalfa crowns affected with this disease were sent in from Josephine county. Since that time it has been reported from a number of sections in Jackson and Josephine counties. It is probable that the disease occurs also in other localities, but our attention has not, as yet, been called to it.

The disease was first described from Ecuador in 1892 and has since been reported from a number of sections in Europe, notably Germany, Bulgaria and England.

So far as is known, the disease affects only the alfalfa. Experiments carried on in an attempt to grow it on clover and other plants have failed.

Symptoms

The disease is characterized by the formation of galls at the crown of the plant. The galls are more abundantly produced at the base of the stem, but may occur on the upper part of the root. The galls in some cases occur several inches above the ground on the stems. They present a very much roughened exterior and vary in size from that of a pea or smaller up to four or five inches in diameter. In form they are often confluent.

Seriously affected plants are killed. Usually the disease will be found in the field in patches in which many of the plants are dead or in various stages of decline. The diseased plants are of a weak growth; the foliage is yellow and the leaves are reduced in size.

Cause

Crown gall of alfalfa must not be confused with the familiar crown gall of trees, small fruits, etc. It is not the same, and it is unfortunate that there is similarity in the common names. Crown gall on trees and small fruits, as noted in another part of this report, is a bacterial disease.

Crown gall of alfalfa, on the other hand, is caused by a fungus of low order, known technically as *Urophlyctis alfalfae.* This is one of the *Chytridiales*, one of the lowest orders of *Phycomycetes.* In this group the mycelium is sparingly developed. The presence of the fungus in the tissues, however, causes a stimulation which results in an abnormal development of the cells of the alfalfa at the point of attack. On the mycelium, resting sporangia are produced by a simple sexual process. These are found in groups in small cavities in the tissue of the gall. These groups may be observed with the aid of a good hand lens, by making a cut through a fresh gall. The sporangia are liberated by the rotting of the galled tissue and serve to spread the disease. When they germinate they produce a number of small motile spores which cause the infection of new plants.

It is probable that the disease has been introduced into the state through seed. It might be disseminated through alfalfa hay. It is possible that it might be carried some distance by the wind and might be spread locally from one part of a field to another or into new fields by accidental transfer of soil in which resting sporangia are present or in which there are bits of decayed galls. This might occur from driving across a field in which the disease is present and carrying the infectious material in soil on the wagon wheels or hoofs of the horses.

Remedy

No remedy is known. When the disease becomes so serious as to render the field unprofitable, a rotation of at least three years' duration to other than leguminous crops should be practiced. The disease might be prevented from spreading in a field, if the spots are observed soon enough, by a complete destruction of the diseased plants. It might be advisable also to hoe the top soil toward the center and thoroughly spray the ground with copper sulphate or Bordeaux mixture. As a general pre-

caution, it might be well to avoid purchasing seed from localities in which the disease is known to exist. Seed disinfection might perhaps be practical, but this has not been demonstrated. Crown gall is a serious disease, and if it becomes general in the state, is likely to cause great loss. It is hoped that all growers will be on the lookout for the trouble and will use every effort to prevent it from spreading. Little is known of the disease as it occurs under American conditions. A thorough investigation of the trouble would be desirable.

Dodder of Alfalfa and Clover

H. S. JACKSON

Cuscuta sp.

A trouble of alfalfa and clover common in the Northwest and somewhat different in nature from any of the diseases previously discussed, is caused by a parasitic flowering plant known as dodder. The dodders are weeds which, as causing a disease of clover and alfalfa, are known to be common throughout the world, including nearly all sections of the United States where these crops are grown.

Kinds of Dodder

Contrary to the usual idea, dodder in clover and alfalfa is not caused by a single kind or species, but by several different species of dodder which may exist upon these hosts. *Hillman gives five species of dodder which are known to affect alfalfa and clover in the United States. Concerning these he offers the following information:

"Clover dodder *(Cuscuta epithymum,* often referred to as *Cuscuta trifolii)* infests both the true clovers and alfalfa indiscriminately. It is widely distributed in foreign countries and in the United States east of the Mississippi river and in the Northern Pacific states.

"Small-seeded alfalfa dodder *(Cuscuta planiflora)* as it occurs in this country appears to confine its attacks to alfalfa in preference to the true clovers. Thus far there is no evidence of any damage from this dodder to red, alsike, or white clovers. This is by far the most abundant and destructive of the dodders in the Western states.

"Field dodder *(Cuscuta arvensis,* as recognized in the botanies) is widely distributed throughout the United States. It infests both the clovers and alfalfa and also many wild herbaceous plants. It has proved injurious to sugar beets in Utah.

"Large-seeded alfalfa dodder *(Cuscuta indecora)* is common in the West, especially in Utah. It infests alfalfa as well as various wild plants, but it does not appear to damage the true clovers.

"Chilean dodder *(Cuscuta racemosa chileana)* is not generally known in this country. It is common in South America and has been reported from Europe. It is said to have flourished for a time in California many years ago, but subsequently disappeared. It is of interest because of its prevalence in alfalfa and red clover seed-producing regions of South America, from which seed is being sent to the United States, for this dodder infests both alfalfa and red clover. Little is known of this dodder in its relation to forage crops in this country, but since it is being brought here in considerable quantity from South America it is very likely that it will become one of the several injurious species established in the United States."

The three most common ones found in alfalfa seed in the Northwest are *Cuscuta planiflora*, *Cuscuta arvenis* and *Cuscuta indecora*. *Cuscuta arvenis* is common upon clover as well and *Cuscuta epithymum* is also common in this state.

Appearance in Field

Dodder may be recognized at a distance by the yellow appearance of spots in the field. At close range this appearance will be found to be due to the abundance of the yellow thread-like dodder plants which twine about the stems of the alfalfa or clover. At first the dodder will be seen only in a small area, infecting one or two plants. It rapidly spreads in all directions by branching of the threads from these to other plants till large areas are covered. During this

* Hillman. Dodder in Relation to Farm Seeds U. S. Department of Agriculture, Farmers Bulletin 306, 1907.

spreading, the plant first infested will gradually be killed by the parasite. The dodder dies with it, but continues to grow along the edges of the spot, so that, in the late season, dead spots surrounded by a circle of dodder infested plants may be observed in alfalfa or clover fields. The dodder in the meantime has blossomed profusely and ripened its seed.

Dodder in General

The dodders, or love-vines, are parasitic flowering plants closely related to the morning glories, or bind weeds. There are several species occurring in this state besides those species which attack alfalfa and clover. Most of these grow on weeds, particularly in moist bottom lands, and do no damage to the farmers' crops.

These plants are peculiar in that they are parasitic in habit, depending on the plants upon which they grow for their food, instead of elaborating it for themselves from the soil moisture and air as plants possessing green color are able to do. Dodders are destitute of this green color called chlorophyll and so have not the power of elaborating food for themselves. The plant consists of a yellow stem which is practically leafless. The leaves have been reduced to very small scales. The flowers are minute and are usually produced in clusters on the stem.

Life History

During the first stages of growth the young dodder plant is self supporting, but is wholly dependent on the food stored in the seed. The seed, when it first germinates, consists solely of a yellow thread-like stem. The plantlet may or may not attach itself to the ground. It grows independently until the food in the seed is used up. During this time the thread-like stem has grown sufficiently to grasp and twine about some green plant growing near by. If this green plant is not one upon which the particular species of dodder naturally grows, it dies. If the plant is one for which the dodder has a natural affinity, it twines about the stem and sends suckers or haustoria into the tissue, thus linking the two plants together. The haustoria serve both as holdfasts for the dodder's support and as feeding organs through which the dodder takes the juices of the host, depriving it of needful food which it has manufactured for its own use.

Propagation and Dissemination

Dodder is most commonly distributed by the seed being mixed with the seed of the host plant. The various species of dodder are common in the districts where alfalfa and clover seed are grown and the seed of both host and parasite are matured about the same time, consequently when an infested crop of clover or alfalfa is harvested, the seed is usually found contaminated with a certain percentage of the dodder seed. In this way the disease is disseminated far and wide. The mixed seeds germinate when planted, whereupon the dodder soon attaches itself to the clover and alfalfa, and after becoming permanently established on one plant may be spread from plant to plant in the field, slowly infesting considerable areas.

When dodder is established in the field it may be disseminated by seed to other parts of the field during mowing and raking. The dodder plant may remain alive for several days on the host plant after it has been cut, and if such diseased plants or parts of plants are scattered to other parts of the field the dodder may obtain a foothold on new plants and thus start other spots. It is shown that in New York dodder (*Cuscuta epithymum*) may live over winter on the crowns of infested plants. The seed of the small-seeded dodder which is so common in the West, may be spread by irrigation water.

Preventive Measures

Since dodder is disseminated almost exclusively through the seed, the most obvious method of preventing the introduction of this trouble is by planting clean seed, that is, seed which has no dodder mixed with it. Certain species of dodder infesting alfalfa may be entirely removed by proper screening. The large-seeded species of dodder cannot be entirely removed by any process of screening known

at the present time. White and alsike clover, on account of their small size, cannot be entirely freed from dodder. Red clover, by thorough re-cleaning, can be entirely freed of clover and small-seeded alfalfa dodder. The size of the screen is important, but sufficient space is not available here for thorough discussion of the processes of separation.

The most logical precaution to take is never to plant seed infested with dodder. This can be accomplished by buying only the best of re-cleaned seed and having it previously tested by an expert for the presence of dodder.

When dodder becomes introduced into a field, the method of eradication is frequently difficult, depending upon the location of the field and the species of dodder. Space will not permit a detailed discussion here of the methods of eradication, and interested growers should apply for information to the Experiment Station, giving a full statement of conditions, or should procure a copy of the farmers' bulletin above mentioned, in which the methods of eradication are fully discussed.

Downy Mildew

Peronospora trifoliorum D'By.

The downy mildew fungus has occurred in Colorado, and is very liable to occur in other states. No suggestions can yet be made as to its prevention.

A. D. S.

Leaf Spot

Pseudopeziza medicaginis

H. S. Jackson

The common disease of the alfalfa known as leaf spot is prevalent in most sections of the country where alfalfa is grown. It is also the most common fungous disease on this crop in Oregon, but under the ordinary conditions is not responsible for large losses.

Symptoms

The disease is characterized by the formation of brown or black irregular spots on either side of the leaf. The spots are most conspicuous, however, on the upper surfaces. They are small, seldom over one-eighth of an inch in diameter, and are scattered irregularly but frequently very thickly over the surfaces of the leaves.

Cause

In many of the spots the presence of little shining amber-colored structures with black margins may be observed by the aid of a good pocket lens. These are the fruiting bodies of the fungus causing the disease which is known technically as *Pseudopeziza medicaginis*. These structures are the apothecia or fruiting bodies of the fungus and contain, in a layer on the upper surface, many cylindrical sacs, called asci. Eight spores are formed in each of these asci.

The general effect of these spots on the leaves is to cause them gradually to turn yellow and fall, so that the plants, where severely affected, may be almost entirely stripped of foliage. This brings about reduction in forage, and, on account of hindering the normal development of foliage, results in interference with root growth which may cause reduction in subsequent crops.

In Western Oregon the fungus is most abundant in the fruiting condition in the fall, when mature spores are produced in large numbers from September to December. It is possible that the fungus, under Oregon conditions, spreads all winter. It is probable that the fungus is disseminated locally most frequently by the wind, but there is evidence to show that it may be carried to new localities through the seed.

A similar disease, which is considered by some authorities as identical with the alfalfa leaf spot, but which is usually referred to by scientists as *Pseudopeziza trifoliorum*, occurs in Oregon on red clover.

Remedy

On account of the nature of the host crop, no very satisfactory remedy for this trouble suggests itself. When the disease appears to be serious in the spring so that the leaves drop abundantly and the forage value is likely to be much reduced in the first crop, it might be advisable to mow the plants early, as this would cause a tendency to throw out new sprouts which would grow vigorously and might escape

the disease. It is also recommended that where it becomes abundant prior to cutting any crop, the plants be mowed a little earlier than usual in order to save loss of foliage.

This disease is seldom serious enough to warrant plowing up a field. Should it ever become so, rotation to other than leguminous crops should be resorted to.

Root Nodules and Root Tubercles Upon Leguminosae

Upon removal of the roots of the clover plant from the soil one finds minute enlargements which are the subject of frequent inquiry. These are nodules or tubercles as they were formerly called, caused by the messmate-living of certain nitrifying organisms, or microbes, with the clover plant. To these microbes in this communal life is due the power of withdrawing nitrogen from the atmosphere and fixing it in the tissues of the clover plants. The same applies in general to the nodules upon plants of this order, the *Papilionaceae*. It thus follows that these nodules are the normal condition of properly nourished leguminous plants of the order *Papilionaceae*, and it likewise follows that the full value of this work of nitrogen fixing is only realized for manurial purposes when the tissues of the clover plants decay in the soil.

Root Rot

Fusarium roseum Lk.—*Gibberella Saubineti* (Mont.) Sacc.

The same parasitic fungus which attacks wheat in the form of scab and also red clover, has been found killing out alfalfa. This fungus may survive in stubble fields where wheat and oats have been grown. It readily kills off the young seedlings of alfalfa and if the soil is not fully prepared for alfalfa seedings, the root-rot may extend its work and further destroy the stand. At present nothing better is known than adequate dressings of lime, preferably raw limestone, for areas to be seeded, together with their proper enrichment. While not specifically noted in America, another root rot fungus somewhat known on other crops (*Rhizoctonia*) has also been reported upon alfalfa from France. Another root rot fungus (*Ozonium omnivorum* Shear) well known upon cotton, also attacks alfalfa in the Southwest.

Rust

Uromyces Trifolii (A. & S.) Wirt

The various sorts of the cultivated clover, red, alsike, mammoth, etc., are attacked by a clover rust. If one will examine the small, dark spots in the clover leaves, he will find a cluster of this reddish fungus beneath. This rust does not spread to other plants than clovers and is commonly regarded as more disfiguring than destructive. It is not nearly so injurious as the leaf spot of alfalfa which is similar in appearance.

Stem Blight

Fusarium roseum Lk.

Stem blight of clover has been found to be due to the same fungus as that of wheat scab. This fungus has been found to cause the death of seedling wheat plants and to follow harvest by attacks on clover stems. It appears at this time to be one of the serious forms of clover sickness. The writer looks upon it as liable to be much more serious even than anthracnose. The only present suggestion for control will apply to control of the wheat scab fungus through recleaning of seed and separation of all scab infected kernels. It is quite likely that clover seedings made in a dry year with little grain scab will not be exposed to the same danger from this blight as those made in wet seasons when the disease is very bad in the grain.

A. D. SELBY

STEM ROT. See *Wilt*, this section.

Wilt or Stem Rot

Sclerotinia trifoliorum

H. S. JACKSON

The disease known as the alfalfa wilt is common. It was first described in Europe but is also recorded in many widely separated sections of this country. It has been reported as serious in New York and California and has recently been found by the writer to be common in Oregon. It was first observed in certain fields in the Willamette valley. It is found to be most abundant and to spread most rapidly during the fall, when the surface of the

ground is more or less constantly moist. It seems to be more serious also where there is a heavy stand of alfalfa.

The disease is known to attack clover almost as seriously as alfalfa. It is probable that this disease is one of the causes for the difficulty frequently experienced in obtaining and holding a stand of alfalfa or clover in Western Oregon.

Symptoms

The disease is characterized by a wilt brought about by rot developed on the stems at the surface of the ground or some distance above. The disease frequently kills the plants and on this account large areas may be found in the field where the plants have been entirely killed out. The roots, however, may not always be destroyed, and may later throw out new sprouts. The rotting is invariably accompanied by a white cottony growth of mold over the surface of the stems and leaves and on the ground around the bases of the diseased plants. In this cottony mold are developed, quite abundantly, black irregular shaped bodies of fungus tissue known as sclerotia. In exceptional cases these are as large as a pea. They may also be found inside the stems of plants which have been killed by the disease.

Cause

This fungus is similar to the one which causes lettuce drop and by some authorities is considered identical, though this has not been proved by careful investigation. It seems best for the present to consider it distinct and to use the name *Sclerotinia trifoliorum.* This fungus develops no summer spores. The cottony growth is the mycelium which is also developed inside the tissues. The sclerotia are resting bodies from which there develops stalked fruiting bodies known as apothecia. These are usually described as developing only after a period of rest, commonly in the spring of the year in nature. In Oregon, however, they are found developing in fall, almost immediately after being formed, without any period of rest. Under our conditions the disease seems to spread most abundantly during the fall and winter, though this has not been as thoroughly investigated as would be desirable.

Remedy

No remedy for diseased plants is known. On account of the nature of the host plants, it is probable that no practical remedy will be developed. Where the disease has become serious, rotation should be practiced. The disease seems to be more abundant on heavy soils, especially where the drainage is not rapid, and such soils, if possible, should be avoided.

YELLOWING. See *Bacterial Blight.*

CLOVER AND ALFALFA PESTS

Alfalfa Crane Fly

Tipula simplex Doane (Family Tipulidae)

General Appearance

The adults are long-legged, slender-bodied insects of a light brown color. The females are wingless while the males are winged and somewhat smaller, lighter in color and with longer, frailer legs. The average length of the adult female is about one-half of an inch.

Life History

The small, oval, dark gray eggs are deposited as deeply into the soil as the length of the female's abdomen will allow. They are laid throughout the early spring and summer. These soon hatch into light colored maggots, which begin to feed upon the roots of plants. When full grown they are from three-fourths to nearly an inch in length—the color being a very dark brown. The maggots remain in moist or wet places, breathing water through spiracles at the posterior end. The pupae greatly resemble the larvae in shape and color until nearly time to develop into the adults, when the wings and legs begin to appear. The body segments are provided with sharp spines which project backwards and by which they are able to wriggle to the surface when ready to emerge. The broods overlap so that all stages may be found. The insect probably hibernates in the larval forms and pupate early in the spring, giving rise to the adults. These bring forth young larvae, which become destructive early in the summer.

Food Plants

The larvae feed entirely upon the roots of plants. Undoubtedly a great variety are attacked. Serious damage has been reported, due to its ravages in alfalfa and clover fields.

Control

The greatest amount of damage is usually done in fields which have long been seeded to alfalfa or clover, where the breeding has not been disturbed. Plowing and thorough cultivation will destroy most of the larvae, which are either crushed or die for lack of sufficient moisture. The females being wingless are unable to migrate sufficiently to cause serious damage in one year. A cultivated crop once in two or three years as a rotation with clover or alfalfa is recommended when the destructiveness of the pest warrants strict remedial measures.

Natural Enemies

Carnes and Newcomer report a tachinid fly as parasitic upon the larvae.

E. O. Essig

Alfalfa Looper

Autographa gamma californica Speyer
(Family Noctuidae)

General Appearance

The adult moths have a wing expanse of about one and one-fourth inches with the body a little over one-half an inch long. The fore wings are light bluish-gray with rose or rust-colored and light markings, a very distinctive feature of which is one shaped like the Greek letter gamma near the middle. The hind wings and body are dull gray. The eggs are hemispherical and pale yellow.

The young caterpillars are light green while the fully developed forms are dark olive-green; head light green; three dark longitudinal lines on the body; a dark spot back of the eye. There are three pairs of well-developed front legs, two pairs of abdominal legs just back of the middle, and one pair at the extreme posterior end. When full grown the larvae attain a length of about one inch. The cocoon is loosely spun of white silk; the chrysalis being brownish black in color, or paler.

Life History

According to J. A. Hyslop, of the United States Department of Agriculture, this insect passes the winter in the pupal and adult stages, the moths appearing early in the spring and are especially active, laying eggs in May and June in the alfalfa fields. The young larvae or loopers are plentiful in June, feeding upon the leaves of the plants. In about two weeks they are full-grown and spin a loose white cocoon among the leaves, in which to pupate. After twelve days the adult moths emerge. The entire life cycle requires about a month. There are two generations a year—the second broods coming on in July.

Food Plants

The larvae are very destructive to alfalfa, working upon the leaves and blossoms. They also feed upon clover, garden peas, cabbage, barley, elder, dock and wild malva.

Natural Enemies

As very well shown by Mr. Hyslop, this insect is so held in check by natural enemies that artificial remedies are yet unnecessary. Internal hymenopterous parasites and tachinid flies are responsible for the good work. In the state of Washington five of the former and two of the latter have been recorded.

Alfalfa Weevil

Phytonomus posticus ..

This threatening pest belongs to the snout beetle family. Its native home seems to have been the shores of the Mediterranean sea. It appeared first in this country in Utah, about 1904. It had spread by 1914 to the greater part of the alfalfa district of Utah, to several counties in the southwestern part of Idaho and several points in Wyoming.

It feeds upon other legumes besides alfalfa but does its greatest damage there.

Life History

The eggs are laid in April, May and June, two to thirty in number in one place in the stems of the alfalfa in feeding punctures. Females, under favorable conditions, lay several hundred eggs during the egg laying period. The eggs hatch

in 10 to 12 days and the larvae begin feeding in the tender stems. After a few days they emerge and find a leaf bud which they enter and feed in concealment. The larva passes through its three moults in three to seven weeks, pupates and emerges in about nine days thereafter.

The adult is less than one-quarter of an inch long and covered with short, dark brown hairs mixed with gray and black. They do great damage to the stems and leaves of the alfalfa. With a few exceptions they do not reproduce until the following spring, overwintering in the crowns of the alfalfa and in trash about the fields. They spread mainly by flight, soon after emerging as adults, assisted by the winds. Also in freight cars, wagons, irrigating ditches, hay, etc. The state of California maintains a quarantine against both Idaho and Utah.

Control

Numerous methods have been tried for the control of the alfalfa weevil. The one that seems to be the most promising on a large scale is that of going over the field after each cutting with a spring-tooth harrow with a wire brush attached. This crushes a good many of the weevils and larvae and raises a dust which is distasteful to them. It also forms a dust mulch helping to conserve moisture and stimulates the alfalfa to vigorous growth. The cost of this method is $2 to $5 per acre, according to Merrill.

References

Utah Experiment Station Bulletin 110.

Bureau of Entomology Bulletin 112.

California Commission of Horticulture, I, Nos. 1 and 10.

BEAN THRIPS. See under *Bean*.

Clover or Almond Mite

Bryobia pratensis Garman

General Appearance

The young mites are red, becoming brown when fully developed. Though very much smaller than a pinhead this species is much larger than any of the common destructive mites in this state. The eggs are very minute, so small as to be scarcely visible to the naked eye; globular and red.

Life History

The eggs deposited in the fall hatch with the first warm spring weather and the mites at once begin to work. Their development is very rapid and reproduction exceedingly great, so by summer there are often sufficient numbers to do great damage. Breeding and work continue until fall, when the eggs are laid and operations suspended until these hatch in the spring.

Food Plants

This mite is an omnivorous feeder and may be found upon a great variety of plants. Peas, clover and alfalfa are severely attacked, while they also feed upon grass, grains and buckwheat. Peach, apple, plum, apricot, prune, cherry, almond and quince trees are also among the food plants.

Control

For this pest Mr. W. H. Volck especially recommends the following formula: Water, 100 gallons; flour paste, 4 gallons; lime-sulphur solution, 5 quarts; iron sulphate, 2 pounds. The flour paste and lime sulphur are thoroughly mixed in the spray tank after which the iron sulphate is added and all thoroughly agitated.

Natural Enemies

The larvae of the minute black ladybird beetles (*Stethorus vagans* Blackb. and *Stethorus picipes* Casey) and the green lacewing (*Chrysopa californica* Coq.) prey upon the clover mite but they do not appear to be important factors in keeping it down.

E. O. ESSIG

GRASSHOPPERS

Valley Grasshopper

Œdaleonotus enigma Scudd

General Appearance

One of the smaller species, the adults being about one-fourth of an inch long. The general color is rich amber with reddish hue around the eyes. The dorsum and carinae of the thorax are dark. The tegmina are mottled with black and dusky spots. The antennae and first two pairs of legs are concolorous with the body, while the femora of the hind legs are richly marked with black and the

tibiae are pale blue. The young are nearly of the same general color, with the dark markings less pronounced.

Life History

The holes in which the eggs are laid are usually drilled in hard or compact soil. The eggs are laid regularly and horizontally and cemented together, as well as being surrounded with a liquid cement which renders the mass waterproof. The young hatch the following spring, as soon as it becomes warm and they begin to reach maturity early in June. Pairing begins soon after and eggs are deposited from August to October. There are two forms of the adults, characterized by long and short wings. The species is very prolific and does much damage. It is only occasionally migratory.

Fig. 1. The Valley Grasshopper (*Oedaleonotus enigma* Scudd). (Original.)

Food Plants

All forms of vegetation, including the foliage of orchards and vineyards, uncultivated field crops, such as alfalfa, clover, grain, etc., and cultivated crops, such as vegetables, corn, potatoes, etc., are attacked.

Differential Grasshopper

Melanoplus differentialis Thomas

General Appearance

This is one of the larger hoppers, averaging one and five-eighths inches from front to the tip of the tegmina or wing covers. A very beautifully colored insect when fully matured. The head, thorax, abdomen and first two pairs of legs are amber or rich brown, the sutures being dark. The wing covers are brownish gray—the true wings being transparent. The hind femora are yellow with black cross lines, while the tibiae and tarsi are bright red, the former with black spots near the outer base. The spines and claws are black. The antennae are reddish with dusky tips. The nymphs are green.

Life History

Egg-laying begins about the middle of the summer. The holes for the eggs are drilled into the soil in bare and vacant places, especially in alfalfa fields. From 60 to 80 eggs are laid by each female. They are protected from winter rains and freezes by an excretion of the female which makes the capsule containing them waterproof. They begin to hatch in the warmer spring months, appearing early in June and keep up their destructive work until August. The young green hoppers, as they mature, acquire wings and assume a yellowish tint, thus causing the belief that there are two distinct species. The largest brood appears early in the summer, and the greatest amount of damage is done by the first of August.

Fig. 1. The Differential Grasshopper (*Melanoplus differentialis* Thomas. (Original.)

Food Plants

Practically all kinds of green vegetation, including most of the forage and truck crops. Especially destructive to alfalfa. Orchard trees and vineyards are also attacked, some trees and vines being completely defoliated and many killed.

Hopper Dozer

The use of the hopper dozer has become an important factor in the control of grasshoppers, especially in grain and hay fields, in pastures and even in cultivated crops. The hopper dozer is constructed as shown in Fig. 1. The back and sides are made of thin sheet iron or cloth and the pan at the bottom constructed to hold about two inches of kerosene. These dozers may be made any length but a two-horse size is the most

practicable. They are simply drawn across the fields and capture the hoppers as the latter endeavor to escape their approach. Though the hoppers may escape from the kerosene bath they are doomed.

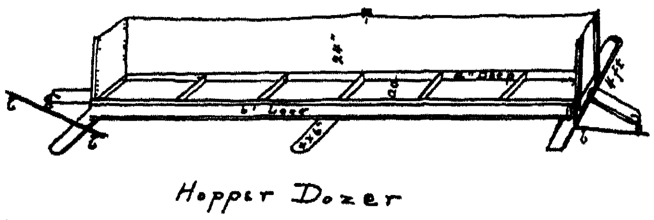

Fig. 1. Plan of a Very Good Hopper Dozer. —*After Libahns*

The best time of operation is on warm days if possible, early in the season before the hoppers have acquired wings.

A brief description of some of the most common and destructive California species follows.

E. O. Essig

Grape Leaf Hopper. See under *Grape*.

Zebra Caterpillar

Mamestra picta Harris

The zebra caterpillar often attracts attention by appearing in considerable numbers in the early fall on alfalfa.

Comstock * describes the caterpillar as of a light yellow color with three broad longitudinal black stripes, one on each side and the third on the top of the back. These stripes on the sides are broken by numerous pure white lines. The pupa is of a brownish color. The adult moth has dark chestnut brown forewings and pale yellow hindwings.

The eggs of this caterpillar are deposited on the alfalfa leaves and hatch in a few days. The young larvae eat the epidermis of the leaves, which soon appear whitish from their attack. They web the tops of the stalks of alfalfa together.

One may go through an alfalfa field and notice here and there plants of which the tops are webbed together and the leaves present a whitish and dead appearance. In the young stages the larvae work in colonies, and only on the upper and consequently more tender portions of the alfalfa plant. I have seen as many as 50 small larvae on one leaf and several hundred on the entire plant. As they become larger they will scatter to adjoining plants, eating the leaves as they go. Often at a radius of several feet from the originally infested plant the larvae may be found working on the leaves.

From September to October the caterpillars on becoming full grown enter the soil to pupate. The winter is passed in this stage, the moths appearing in the spring. There are probably several generations, but the last generation in the fall is the one in which the larvae are numerous enough to attract attention.

At present the best method for the control of this pest on alfalfa is to go through a field picking and destroying infested tops, which are conspicuous because of their whitish color, when the larvae are in the young stages and consequently massed on one or two stalks. If the fields are pastured at this time of the year very little damage will result from this insect's attack.

This insect occurs in the Atlantic states, Colorado, Utah and California.

Besides alfalfa, it attacks cabbage, celery, beets and other garden vegetables.

E. J. Vosler,
Cal. Com. Hort. II, 11.

* Manual for Study of Insects, page 305.

Cocoanut Palm

The cocoanut palm grows in the tropics along the seashore in rich sandy soil. It is native to the islands of the Indian ocean and is now widely distributed throughout the tropical countries of the world. The only part of the United States where it grows in any considerable quantities is in the southern part of Florida, but even here it does not succeed so well as farther south, showing that it must live in a climate practically free from frost.

Geological specimens have been discovered in Central and South America, showing that it once had a much wider distribution than at present. In the tropical islands it has been discovered to be one of the first trees to find a foothold upon the newly formed soil. It is a luxurious grower, often reaching a height of more than 100 feet with leaves from 10 to 20 feet in length. At the bases of the leaves appear large yellow or white flow-

ers followed by large, hard-shelled nuts. The tree usually begins to bear at the age, or about the age of ten years, and continues fruitful for more than half a century. It flourishes best in lands near the coast that are so sandy and shelly that little else will grow.

The cocoanut is propagated wholly from seeds, which when planted in the nursery, and grown for commercial purposes, are planted in rows, and when the plants are large enough, are transplanted into the orchard and set about 20 to 30 feet apart. For a few years, they are given clean cultivation, and then allowed to shift for themselves because they grow in soil not adapted to other vegetable growths.

The cocoanut palm is one of the most important nut trees of the world. Its fruits are used in many ways in the tropical countries, either cooked, raw, ripe or unripe. Large quantities are exported to temperate climates, where it is used by confectioners for the making of candies, cakes and bread. The oil is used in making candles, soap and for cooking. The central parts of the stems of the young plant and the terminal buds of the old plant are often used as vegetable food or salad. The dried leaves are used for thatching and there is a sap drawn from the young spathes, out of which a pleasant drink is made. The lower wood of the old trunk is used in cabinet making, the fiber is sometimes used for cordage, while the shell is used for drinking cups, bowls, bottles and sometimes polished for ornamental purposes Perhaps there is no fruit more profitable, in proportion to the amount of labor expended in its production, than the cocoanut.

GRANVILLE LOWTHER

Cola Nut

A small tree, growing to the height of 20 or 40 feet, native to the west coast of Africa and about 500 miles into the interior between Sierra Leone and Lower Guinea. The tree has become naturalized in the West Indies and Brazil. There are about 14 species of trees, and the fruit, or nut, is supposed to possess a stimulating power as well as nutritive value that sustains the natives in great feats of endurance.

It bears a profusion of purplish flowers, from which grow a brownish yellow fruit, which encloses a nut of red and white seeds. In its tenth year, the tree reaches its maturity, so that it bears more profusely than at any other period. The seeds ripen in October or November and will yield as much as 125 pounds per tree.

The extract of the nut is believed to possess medicinal qualities and has recently come into use in many parts of the world as a beverage.

GRANVILLE LOWTHER

Colorado

Colorado gets its name from the Colorado river, a name meaning "red or reddish." It is 380 miles from east to west, and 275 miles from north to south, making a land area of 103,645 square miles or 66,332,800 acres.

Colorado includes an important part of the Rocky mountain range, which is the natural divide between the drainage systems of the Middle states, and the Pacific coast states. Much of it is rough and fit only for mining and grazing, which industries yield its principal wealth. It contains more land at higher altitude than any other state in the Union. About three-sevenths of the state is an elevated plateau, rising gradually from east to west, until it reaches the vicinity of Denver. East of this its water drains through the South Platte and Arkansas Rivers into the Missouri and Mississippi and into the Gulf of Mexico. Westward its waters drain through the Colorado river into the Gulf of California. The eastern one-third of the state is part of that great plain called the Mississippi valley, the western portion of which a generation or two ago, was considered a part of the "Great American Desert," but which is now being rapidly brought under profitable cultivation.

In the mountainous portions are narrow valleys of alluvial soil, washed from the mountain sides, some of them rich

and well adapted to farming and grazing. The orchards are almost always in the valleys, for several reasons. First, the elevation is too great, and the climate too severe, in the higher lands, for the growing of fruits. Second, generally irrigation is required for the growing of fruits, and irrigation is not possible on the high plateaus. Third, orchards need to be sheltered from the winds and for that reason need a cove, valley or protected place. From her many peaks and high mountain ranges, the highest portions of which are always covered with snow, hundreds of streams are fed, from which water can be diverted for irrigation, and thus some of the valleys are becoming sources of plenty.

Fruit growing is the leading industry, in the counties of Delta, Mesa and Montrose, along the Grand river. It is here that the famous Grand Junction district is situated. On the Arkansas river, the principal fruit section is around Canyon City, although considerable fruit is grown farther down the river near Pueblo and farther east. Canyon City is famous for its cantaloupes, as also is the Rocky Ford district which has given its name to the netted gem variety of cantaloup.

Prof. E. R. Bennett, of the Colorado Agricultural college, thinks that fruit growing in mountain districts is in a class by itself. He thinks that the Rocky mountain district differs from any of the other four great districts of North America. The districts here referred to are doubtless the Pacific coast states, the Alleghany mountain region, the Ozark mountain region and the region of the Great Lakes. He has the following in substance to say in regard to the differences. "The difference is primarily due to altitude. Plant tissue in the high altitudes is characterized by a delicacy of cell structure which, noticably in forest trees, makes them brittle. Such trees for instance as the elm, ash and maple which easily withstand the heavy ice storms of the East, are frequently broken in Colorado by storms less severe. This is manifest in fruit in a finer texture so that apples, naturally tough in character, are better when grown in the Rocky mountain district than when grown in lower altitudes. Another fact, that may be either good or bad, is that high altitudes tend to make flavor less prominent. For this reason, the Baldwin and Greening are desirable varieties when grown in New England, but are too insipid when grown in Colorado. On the other hand, the Jonathan grown in the high altitudes is just sufficiently toned down to give it a desirable flavor, without that acrid taste which characterizes it when grown in the East. Another feature of the orchard industry in Colorado (and in all the Pacific coast states as well) is the early bearing habit of the trees. In the East it is not expected that an orchard will bear to any considerable extent until it is from 8 to 15 years old, while the Colorado orchards will make a much more rapid growth and bear at half that age.

"The apple is the most important fruit of the Rocky mountain district. The number of bearing trees in Colorado is over 2,750,000. In 1910 there were of all kinds of fruit trees set 1,873,870. In 1911 it is estimated there were about two millions. It is difficult to estimate the value of orchards in the Rocky mountain district as these vary considerably with the different places in which they are grown. Some are located in small valleys more or less distant from railroads, and where the lands are not well advertised. In such places bearing orchards would sell for $200 to $500 per acre. In other places, where the orchard areas are larger, the transportation facilities better, and where more advertising has been done, orchards will sell from $700 to $2,000 per acre. The yield per acre for bearing trees is from 150 to 500 boxes; perhaps an average of 250 boxes per acre would be a fair estimate. The net income per acre will probably be all the way from $100 to $200.

"The apple-growing industry in Colorado is rapidly increasing because of the average high market price received for Colorado apples. Apples sell in the markets of the East at a higher price than from any other district except those of the Northwest, so that the proposition

from the standpoint of the grower is one of high-class fruit. Colorado orchardists do not claim that fruit can be grown cheaper in the Rocky mountain district than in the East, or that cheap grades of fruit are profitable in this district. The aim of the orchardist is to grow fruit that will sell in the best markets rather than fruit for the low class trade of the country.

"From the standpoint of soils it would be hard to say what would be considered a typical Colorado soil. Orchards are successfully grown on soils all the way from heavy, adobe bottom lands to the lightest sand and gravel soils of the higher mesas. The essential thing is sufficient fertility and water enough to enable the trees to develop the fruit in the best manner.

"The most important fruit for the Rocky mountain district aside from the apple is the peach. Peach growing in the state is largely limited to the protected valleys where the air drainage is such as to give a minimum of losses from late spring frosts and extremes of cold in winter. Palisades in the valley of the Grand, Paonia in the North Fork valley, and a few other districts comprise the larger part of the peach territory of the state. These lands that are particularly well adapted to peach growing have become world famous for their great returns from peaches. A thousand dollars per acre was once not an uncommon return from peaches, and peach orchards have been sold as high as $4,500 per acre.

"The pear is still more localized in its production owing largely to the ravages of the pear blight which has made pear growing a precarious business in some districts. Districts that are well adapted to pear growing and are not seriously troubled from this disease, have made big returns from the industry. The pear, however, is not increasing in production in this state to any such extent as are many of the other fruits.

"Not the least important of the fruit products of Colorado is the cherry. The cherry is adapted to a greater variety of soils and conditions in Colorado than any of the other fruits except possibly the apple, and in fact the cherry will grow without irrigation in many districts where the apple is not particularly successful. In the west slope districts as in the valleys of the Grand, Uncompahgre, North Fork, Animas and in Montezuma county, the sweet cherry is grown possibly more extensively than the sour. On the east side of the mountains the sour cherry predominates. Of the sweet cherries, the Royal Ann (Napoleon), May Duke, Royal Duke and Bing are more largely grown. Of the sour cherries the Montmorency, Morello or Wragg are the leading varieties. The sweet cherry is largely marketed fresh in boxes. Some of the sour cherries are utilized in the same way, although there is a growing tendency towards canning the product at canneries near the orchards. The cherry will make a gross return of from $200 to $400 per acre, and is one of our most dependable fruits as fewer failures come in cherry growing than with most other fruits."

Grand Valley

The Grand valley is situated on the western slope of the Rocky mountains, in Mesa county, and extends westward to the Utah line. It has an altitude of about 4,600 feet, is about 40 miles long, and 6 to 10 miles wide. It contains approximately 150,000 acres of land, capable of irrigation, some of which is already under water and planted to orchards, while about 60,000 acres will come under the Government irrigation project now in the process of construction. The principal crops are apples and peaches. Of the varieties of apples best adapted, the Jonathan is the favorite. Here the soil and climatic conditions seem favorable for its growth and a high state of perfection is reached.

Granville Lowther

Grand Junction Weather for the Past Sixteen Years

Temperature

The mean annual temperature is 52.6 degrees. The highest annual mean was 54.5 degrees in 1900, the lowest 50.1 degrees in 1903. The highest temperature ever recorded was 104 degrees on June

23, 1900, the lowest —16 degrees on January 26, 1898; other low temperatures were —15 degrees, February 7, 1903; —14 degrees, February 14, 1905, and —12 degrees, February 6, 1899. The coldest month was February, 1903, with a mean temperature of 15.2 degrees, the warmest was July, 1901, with a mean of 82.0 degrees. In February, 1903, there were 14 days on which the temperature was below zero. In July, 1901, there were 12 days with temperature 100 degrees or more, and the temperature exceeded 90 degrees on every day of that month.

Precipitation

The mean annual precipitation is 8.22 inches. The greatest annual fall was 11.61 inches in 1906, the least, 3.64 inches, in 1900; other heavy falls were, 11.25 inches in 1897, 10.87 inches in 1899, 10.85 inches in 1895, and 10.25 inches in 1905. The greatest monthly fall was 3.76 inches in September, 1896, and the least, none, in September, 1892, and November, 1904. The greatest fall ever recorded in any 24 consecutive hours was 2.16 inches on September 22-23, 1896. The average annual snowfall is 19.0 inches. The greatest annual amount was 35.9 inches in 1905, the least, 1.2 inches in 1900.

Wind

The average hourly wind velocity is 5.1 miles per hour. The prevailing directions are S.E. and N.W. The highest velocities recorded were 41 miles per hour from the N.W. on February 22, 1900, and 41 miles from the S.W. on April 1, 1903. The winds are generally E. to S.E., from midnight to noon, and W. to N.W. from noon to midnight.

Sunshine and Cloudiness

The sunshine has averaged 70 per cent of the possible amount. The month of greatest sunshine is July; of least, January. The average of clear days is 193; partly cloudy days, 102; cloudy days, 70. The average number of days with fog is 1; with hail, 2; with thunderstorms, 35; with .01 inch or more precipitation, 57; with .04 or more precipitation, 40.

Compiled from U. S. Weather Bureau Records.

Frost and Precipitation for Colorado

Station	Frost				Precipitati'n
	Average Date of		Date of		
	First Killing in Autumn	Last in Spring	Earliest Killing in Autumn	Last in Spring	Annual inches
Fort Collins	Sept. 21	May 13	Sept. 7	June 5	14.6
Leroy	Sept. 26	May 5	Sept. 12	May 26	15.0
Meeker	Sept. 12	June 7	Aug. 23	July 4	15.0
Pagoda	Sept. 8	June 10	Aug. 20	July 19	19.7
Silt	Sept. 25	May 18	Aug. 27	June 6	11.8
Breckenridge	....	....	....	....	26.8
Denver	Oct. 4	May 7	Sept. 12	June 6	13.7
Cope	Oct. 3	Apr. 27	Sept. 11	May 22	18.4
Grand Junction	Oct. 29	Apr. 11	Sept. 14	Apr. 30	7.7
Colorado Springs	Sept. 28	May 1	Sept. 12	May 23	14.3
Hamps	Sept. 21	May 16	Sept. 6	June 8	13.1
Montrose	Sept. 29	May 10	Sept. 8	May 28	9.3
Gunnison	....	....	....	....	8.9
Salida	Sept. 7	May 30	Aug. 25	July 7	9.7
Pueblo	Oct. 15	Apr. 28	Sept. 12	May 23	11.6
Las Animas	Oct. 6	May 2	Sept. 7	May 19	11.4
Saganche	Sept. 17	May 24	Sept. 10	July 6	7.1
Durango	Sept. 22	May 13	Aug. 24	June 12	15.9
San Luis	Sept. 11	June 9	Aug. 25	July 5	11.9
Hoehue	Oct. 2	May 10	Sept. 13	July 4	13.0
Blaine	Oct. 6	May 13	Sept. 7	May 22	15.3

Composition of Irrigated and Non-Irrigated Fruits

J. S. Jones and C. W. Colver in Idaho State Bulletin No. 75 report an analytical study of orchard and small fruits, with special reference to the effect of irrigation on those compounds which materially influence quality in fruit. Although the attempt has been made to compare similar varieties of fruits growing both under irrigation and non-irrigation, data were secured with regard to as many varieties as possible whether grown under both conditions or not. The principal determinations made include total solids, acidity, invert and cane sugar, nitrogen, ash and waste. The leading commercial districts of Idaho were represented and all samples were grown at elevations less than 3,000 feet. The analyses are here grouped and discussed under the three divisions of drupaceous, pomaceous and small fruits.

Summarizing the results it appears that there is a fairly well-defined tendency for apricots, cherries, nectarines, peaches, plums and prunes to elaborate greater percentages of solid matter when grown in the non-irrigated sections. With the exception of Italian and Petite prunes, however, such differences in sugar and acid are too small to seriously affect taste. There was a remarkable uniformity of composition within each of the several varieties of apples analyzed. The non-irrigated varieties contain slightly greater percentages of acid and sugar, but the differences practically disappear when these constituents are calculated to the dry or solid matter. Apples grown with irrigation contain the smaller percentage of solids insoluble in water, and the non-irrigated apples containing appreciably higher percentages of crude protein, and consequently may have a slightly higher actual food value. In intensity and uniformity of color, also in percentage of waste, irrigated apples are somewhat superior to the non-irrigated.

With the exception of strawberries there were but slight differences in percentage of solid matter and in the total sugar content between the irrigated and non-irrigated small fruits. The non-irrigated small fruits, however, contain appreciably greater percentages of acid and of crude protein.

From a survey of the analytical results as a whole the authors are led to conclude that fruits in general manifest a well-defined tendency to elaborate greater percentages of total solids or dry matter, consequently of sugar, acid and crude protein when grown in non-irrigated sections, but that with comparatively few exceptions no marked difference between irrigated and non-irrigated fruits in actual food or market value should be charged to differences in composition.

Cost of Hauling Fruits to Market. See under *Marketing*.

Connecticut

Connecticut has an area of 4,850 square miles. It may be divided into coast land, central low land, and eastern upland. The central lowland is in the valley of the Connecticut river and is a sandy loam well adapted to diversified agriculture. That which is true of the Connecticut river is also true of the bottoms along the other streams, except that the valley of the Connecticut is larger than any of the others. The soil in the upland is, for the most part, a heavy clay. There is a considerable difference in the periods of the ripening of fruits. In the bottoms the climate is warmer on account of the radiation of the heat and sunshine from the hillsides, and the soils are sandy and warm, and therefore, produce crops that mature and come into the markets before the fruits of the same varieties on the uplands are ready to pick.

Apples grow anywhere in the state, but the hills and the uplands produce the best winter varieties because they have the best keeping qualities, and therefore bring the highest price in the market. The soil of the hills seems well adapted to the growing of the best varieties.

Peach growing in Connecticut is proving to be an important industry. The only trouble seems to be on account of the danger of frosts that kill the buds in the

early spring. It is estimated that on the lowlands there will probably be a loss of two crops out of five, while on the hills there is less danger, and there will be a loss of one crop out of five, or one out of four, and there are a few favored spots where there is scarcely any danger from frosts. The peaches of Connecticut are of a very fine quality, well developed, finely colored, and bring good prices in the city markets.

Grapes and pears are successfully grown in all parts of the state, and the small fruits do well. The only crop that seems not to succeed well is the cherry, of which it is estimated that there are scarcely enough grown to supply the home demand.

GRANVILLE LOWTHER

CO-OPERATION, FUNDAMENTALS OF. See *Marketing*.

Corn

This cereal is so common in the United States that it is scarcely necessary to devote space here to a description of its cultivation. For garden purposes there are three kinds in general use.

The first is the common field corn, cooked when the ears are not yet mature but after the grain has formed and called "roasting ears."

The second is "sweet corn," cooked in much the same way and used largely for canning.

The third is "pop corn," which after maturity and being thoroughly dried, is heated to a temperature which will cause it to explode into white crisp grains.

The field corn requires earlier planting than the other varieties because it is larger and it takes longer to bring it to maturity.

Sweet corn may be planted as soon in the spring as the danger of frost is past, and then if there are successive plantings every two weeks, it may be gathered for use from July until late in the autumn.

Pop corn is small and matures early.

Plant the seed in hills about three feet apart each way. While corn will grow on almost any kind of soil, a deep rich soil is preferable.

GRANVILLE LOWTHER

COVER CROPS. See *Apple Orchard, Cultivation of.*

COW PEAS. See *Apple Orchard Cover Crops.*

Crab Apples

In speaking of crab apples, most old settlers think of the "Native Wild Apples" which grew in the forests of the Eastern states, or in strips of timber and clumps or groves in the prairie states and the Oregon crab apple native to the Pacific coast.

The native wild apples, *Pyrus coronaria*, were found by the early settlers in Canada and all the eastern and middle portions of the United States. The flowers are large showy, white or rose colored and delightfully fragrant. The fruit ripens late, is sour, almost bitter, and was used by the frontiersmen mostly for making preserves. In the prairie states, this species varied so that some have regarded it a separate species and have named it *Pyrus iowensis*. The fruit is small, measuring from less than an inch in diameter to two inches.

Pyrus augustifolia is the native crab of the Southern states; is much like *Pyrus coronaria*, and need not be further described.

Pyrus rivularis, the Oregon crab apple, has rather small white flowers and the calyx lobes become deciduous from the mature fruits. The fruit is about three-fourths of an inch long, oblong, yellowish or blushed, and ripens in autumn. It is used by the Indians but is not cultivated.

Cultivated Hybrids

There are four varieties of cultivated hybrids, generally called crabs. These are the Soulard, Howard, Mercer and Kentucky Mammoth.

Common Crab Apple

The crab apples which we cultivate for their fruit are for the most part hybrids between the apple, *Pyrus malus*, and the primitive Siberian crab, *Pyrus baccata*.

The principal list of Siberian crab apples and their hybrids are as follows:

Bailey Crimson; fruit medium or large, skin yellow and shaded with a deep rich crimson.

Brier; tree vigorous and hardy, comes into bearing young, skin pale yellow, washed with a lively red.

Cherry; fruit medium to large, skin pale yellow, nearly covered with bright red.

Coral; fruit of good size, brilliant color, sprightly subacid in flavor, season October to February. The tree is a good bearer, and comes into bearing early.

Currant; fruit small, borne in clusters, of no commercial value.

Dartmouth; fruit large, brilliantly colored, good in flavor and quality. The tree is not a vigorous grower but comes into bearing early and yields full crops in alternate years.

Excelsior; fruit very large, nearly as large as the medium sized apple; very attractive in appearance and excellent in quality for either dessert or culinary uses. Tree a good strong grower, hardy, healthy and comes into bearing early, yields crops on alternate years. Skin smooth, yellow, shaded and splashed with red.

Florence; tree bears young, is a reliable cropper, prolific, fruit of good size, very attractive in appearance, of good quality, mostly overspread with a brilliant pinkish red.

Gibb; fruit large, yellow blushed with dull red, highly esteemed for canning, season last half of September. Tree well adapted to northern sections, slow grower but very productive.

Hyslop; fruit large, very brilliantly colored, dark red or purplish, overspread with thick blue bloom; borne in clusters. The tree is a good grower, very hardy, and a reliable cropper, heavy crops every second year, sometimes annually.

Large Red Siberian; fruit of medium size for the Siberian, being larger than the Red Siberian, but smaller than the Transcendent or Hyslop. Tree is a vigorous grower, hardy, healthy, and a heavy cropper, bears biennially, sometimes annually.

Large Yellow Siberian; fruit large, clear pale yellow with a shade of red. Tree medium in size, moderately vigorous, very hardy, healthy, comes into bearing young, is very productive. Is generally superseded in the markets by the larger varieties.

Marengo; very good variety for home use, where late keeping is required, but larger and more attractive varieties are generally preferred.

Martha; fruit large, very handsome clear yellow, more or less overspread with a bright red; excellent in flavor and quality. Tree medium size, very hardy, comes into bearing young, yields good crops annually. Season from September to late fall.

Minnesota; fruit very large for its class, skin pale yellow blushed or mottled on the sunny side, flesh white, firm, crisp, season from September to October.

Montreal Beauty; a very beautiful fruit, tree less hardy than the Transcendent, does not come into bearing early, but bears heavily. Fruit large, for its class, yellowish green mostly covered with red.

Oblong; fruit medium size, medium all around and not generally recommended.

Orange; regarded by some as a desirable variety for both home use and market, but no distinctive characteristics that make it particularly desirable.

Paul Imperial; fruit small to medium, somewhat irregular in shape, of very good appearance but less attractive in size and color than the Hyslop, and inferior to the Martha in quality. Tree below medium in size, comes into bearing young and is an annual cropper.

Picta Striata; fruit handsome, rather mild in flavor, but is hardly large enough for a good commercial variety.

Quaker; a late ripening variety only fair in quality, size medium to large; color yellow with red cheek, tree handsome but not very productive.

Queen Choice; fruit medium or above in size, of a beautiful crimson color, showy and attractive, tree vigorous, very prolific.

Red Siberian; fruit small, decidedly ornamental, borne in clusters. Skin smooth, pale yellow, striped and blushed with a lively red overspread with a bluish bloom.

September; a very handsome fruit of good quality; ripens a few days later than the Transcendent, in September. Tree a

good grower, comes into bearing young and yields good crops biennially.

Soulard; is regarded as a hybrid between the common wild prairie crab and the common apple. It originated on a farm near St. Louis, Mo. It is large, of good quality, and one of the most desirable of all varieties produced in the United States. It is good when baked, makes excellent jams, jellies and preserves, hangs on the tree until late frost and will keep in common storage for a year. Tree perfectly hardy. It seems not adapted to the Northeastern states, and in some other portions of the United States has not been sufficiently tested.

Transcendent; a beautiful fruit and one of the most popular. Tree a good grower, hardy, very prolific, fruit medium to large, clear bright yellow with red cheeks; season late in August to middle of September.

Van Wyck; a sweet crab apple, fruit large for a Siberian crab, whitish, shaded with bright red covered with bloom; inclines to watercore; season from August to September.

Whitney; one of the most popular of the large crab apples, especially in the West and North. Tree is thrifty, upright grower, comes into bearing young and is very productive. Season, August and September.

Yellow Siberian; is sometimes called the Golden Beauty. It is similar to the Red Siberian, except for size it is larger, and in color it is a clear golden yellow. Under certain circumstances it suffers from blight. It comes into bearing young, is a vigorous grower and a heavy annual cropper.

For further information as to the culture and the adaptation of crab apples to special locations, see *Apple*.

GRANVILLE LOWTHER

CRABS, AMERICAN. See *Apple, History of.*

CRAB APPLES, GRADE RULES FOR. See under *Apple Packing.*

CRABS, EUROPEAN. See *Apple, History of.*

CRABS, NATIVE, FUTURE OF. See *Apple, History of.*

CRAB, SOULARD. See *Apple, History of.*

CRABS, WILD. See *Apple, History of.*

CRABS, SMOOTH, WILD. See *Apple, Botany of.*

CRABS, HAIRY, WILD. See *Apple, Botany of.*

Cranberry

There are two species of cranberry; one is known as the Little Cranberry, *Vaccinium oxycoccus*, and the other as the Large American Cranberry, *Vacinium macrocarpon.*

The American cranberry grows wild along the Atlantic coast from Maine to New Jersey, and in small areas along the Allegheny mountain range from Southern Pennsylvania to North Carolina. It grows also in some of the Middle states like Michigan, Wisconsin and Minnesota.

The number of acres planted to cranberries according to the census reports of 1910 are as follows: Connecticut, 275; Illinois, 1; Indiana, 70; Iowa, 1; Kansas, 1; Maine, 90; Massachusetts, 5,128; Michigan, 150; Minnesota, 22; Nebraska, 1; New Hampshire, 23; New Jersey, 8,356; New York, 113; Oregon, 6; Rhode Island, 300; South Dakota, 1; Washington, 5; Wisconsin, 5,821.

One of the most surprising things in the study of cranberry culture is the average number of bushels per acre in the sections where the fruit is grown for commercial purposes. The lowest average per acre is in Maine, where it is 17 bushels. The highest average per acre is Oregon where it is 119 bushels per acre. Next to Oregon is Massachusetts giving an average yield of 117 bushels per acre and next to Massachusetts, New York with 96 bushels per acre. The average for the cranberry producing states is within a fraction of 47 bushels per acre. It would appear therefore that the states producing above this average would make the industry profitable, and that Oregon and Massachusetts should make it very profitable.

Structurally the cranberry is allied to the blueberry or huckleberry; but botanically it is classed as a distinct species.

Soils Best Adapted

It is necessary to success in cranberry culture that the soil should be very rich

in humus, boggy and mixed with sand. The water should be within a few inches of the surface, and during the growing season, the whole area should be flooded as in the growing of rice in the South. The cranberry is not, however, a Southern plant but grows either in the northern latitudes or the high altitudes which make the climate equivalent to a northern latitude. On account of the necessity of maintaining a water level, land should be chosen that has a substratum of hard pan, impervious clay, or something that holds the water, so that while the plants are growing the water may be held from six to ten inches below the surface, and when they are fruiting the water should be held at from one to two feet deep below the surface.

On this account, the land should be level, or it cannot be uniformly covered to a sufficient depth. In order to do this, it is better to make a small embankment around the tract to be irrigated. These embankments need not be more than about three feet in height, and if the land is sufficiently leveled, they will hold the water to any depth needed in the growing of the fruits.

Grading

The work of grading the land should be done with a good deal of care, destroying all roots of plants, shrubs, and whatever may obstruct the growth of the fruit. The land should be then carefully smoothed down to a level and sanded. The sanding is a process that may require much labor, depending on the distance sand must be hauled. The sand should be scattered over the land to a depth of about four inches.

Propagation

The propagation of the cranberry for commercial purposes is by means of cuttings, but for the production of new varieties seeds are planted as in most other kinds of fruit. The cuttings are planted as early in the spring as possible and the land kept sufficiently flooded to protect the plants from frost.

Methods of cranberry culture differ in different localities. L. C. Corbett, Horticulturist for the Department of Agriculture, conducted an investigation some years ago into this subject and the results are in part embodied in what follows.

Cuttings

* New cranberry meadows are almost always established by planting cuttings. The sanded surface of the area to be planted serves as the propagating bed for the cuttings as well as the home for the established plants. The cuttings consist usually of portions of shoots of the variety to be grown, 10 to 15 inches long. The common practice is to secure the cuttings from vigorous plants by mowing a portion of the meadow with a mowing scythe. The portions of the vines thus secured are then transported to the area to be planted and separated into wisps containing from 8 to 15 separate stems. The wisps are placed at the intersection of marks made to indicate the interval between the plants, usually 18 by 18 or 9 by 18 inches. The cuttings are then forced into the sand with a broad, thin, wedge-shaped dibble. The blade of the dibble is placed midway of the wisp of cuttings, so that the pressure exerted upon the cuttings doubles them upon themselves and at the same time presses them firmly in the soil.

While the above statement explains the usual method of propagating the cranberry, new meadows have been established by running the cuttings through an ordinary hay or straw cutter, thus reducing them to fragments about one inch long. By sowing these fragments in rows or broadcasting them upon the surface, a stand of plants may be secured. Cuttings of the cranberry intended for shipment should be loosely packed in well ventilated barrels, baskets, or crates. More injury results from the heating of the plants in closely packed, unventilated receptacles than from drying in well ventilated ones.

Harvesting

In early days of cranberry culture harvesting was necessarily done by hand. As the industry expanded, the increased demand for pickers rendered it necessary

* Farmers' Bulletin No. 176

that in order to hold the cost of production within reasonable bounds some mechanical device be found which would lessen the cost of harvesting by increasing the quantity an individual is able to pick. This demand has been met by cranberry rakes, which effect a decided saving of time and expense, as one person can gather 75 to 80 measures of six quarts each in a day, while a hand picker can not gather more than one-half of that quantity. There is considerable prejudice among growers against the use of these harvesting devices because of some real or imagined injury to the bogs. This prejudice, however, seems to be disappearing; at least the use of the harvesters is each year becoming more general.

Harvesting is paid for, as a rule, by the measure. Each person is furnished with a rake and with pails or boxes in which to place the berries as picked. The meadow is then laid off in sections or strips by stretching lines across it. Each picker is assigned to a division. By this arrangement each one gets his share both of heavily and sparsely fruited plants, and the grower is certain of getting the product from all parts of the meadow. This has not been as satisfactorily accomplished in any other way. After being picked the fruit is carried to storehouses, where it is allowed to remain, until assorted, in the trays in which it was placed at picking time. The trays are of various dimensions to suit the fancy of the grower, but most of them hold about three measures (18 quarts) of fruit each.

Assorting

As the berries come from the field there are many broken branches, leaves and defective fruits among them. To remove the leaves and branches, various cleaning devices similar to the fanning mills used for cleaning grain have been invented. After having been winnowed in this fashion the fruit is spread upon assorting racks. Operators sitting upon either side of this device look over the berries in much the same manner as beans are looked over in hand picking. From the assorting table the berries go into barrels, a few only being crated.

Storing

Cranberries as they come from the field are immediately placed in storage buildings upon the plantation. It is the prevailing practice to hold the fruit in the storage houses at the bogs until the market is ready, which is from six weeks to three months after harvest. No artificial cold is needed in the storage houses. The only precaution necessary is to prevent the fruit from freezing, which frequently requires the use of a little heat in the storage house.

In early times it was thought necessary to pack the berries in casks and cover them with water in order to preserve them for any length of time, but this idea has been abandoned, and the fruit is for the most part stored in small open boxes.

Marketing

The fruit, as cleaned, assorted, and barreled, usually in ventilated barrels, is put on the market. The barrels are similar to those used for packing apples for the domestic market, and are practically of the same size. In the retail stores cranberries are more often found in bushel crates than in barrels. The crating of the fruit is done by the middlemen, who act as distributing agents, rather than by the producers. The dealers prefer that the growers pack the product in barrels.

Prices

By an examination of the price lists of the New York market from 1870 to 1902, it is found that the prices of cranberries have varied widely in that time. The lowest ranges of prices quoted were in April, 1879, when the berries sold at $3.50 to $4 a barrel; November, 1899, $4 to $7.50; April, 1889, $3.50 to $5.50; November, 1896, and January, 1897, $5 to $5.50; April, 1897, $3.50 to $5; and November, 1901, $6 to $7. The highest prices noted were $15 to $16 a barrel in April, 1874; $14 to $15 in April, 1876; $13 to $13.50 in January, 1884; $13 to $14 in March, 1895; and $10 to $12 in January, 1903. No prices are accessible for 1880, 1881, 1882, 1884, 1885, 1887, and 1888. The usual price has been from $7 to $10 a barrel.

Varieties
Selection for Planting

The kinds of cranberries vary as greatly in productiveness and habits of growth as do apples or peaches. As a result of this variation, many of the early planted bogs were not profitable, and had to be torn out and planted with a variety of greater commercial value. As with apples, those sorts which are largest and command highest prices upon the market are frequently shy bearers, and are only grown in limited areas to satisfy the fads of special markets. The question of the varieties best suited to any given section is one of a local nature, and must be determined by trial. In sections yet to be developed it may be found that the climate and soil conditions are particularly well suited to sorts that are shy bearers in the Cape Cod region, or the opposite may be true. For that reason those contemplating taking up this industry in a new section will do well to secure a number of different varieties of good repute from the various cranberry districts, rather than to place entire dependence either upon native stock or even the best sort from any other region. The history of the development of regions growing other standard fruits indicates that varieties are local.

CRANBERRY CULTURE IN THE PACIFIC NORTHWEST

C. N. Bennett
Clatsop Cranberry Bogs.
July, 1913.

General Description

Cranberry culture was established in Massachusetts about 1810; in New Jersey about 1850 and in Wisconsin about 1880, although the berries were gathered for commercial purposes from the wild vines many years before these dates. While these three states produce practically all the cultivated cranberries, they are grown in about one-third of the states. The United States is the only country where they are grown commercially.

In the Pacific Northwest the industry is comparatively new, but is by no means an experiment as bogs were established both in Pacific county, Washington, and Coos county, Oregon, about 1890, and at present they are grown commercially from Coos bay, Oregon, to Puget Sound, Washington.

There are probably not over 100 acres of bearing bogs along the Pacific coast, and the greater part of these have been neglected and are in poor condition, but there are a few bogs, where the owners understand and care for the bogs properly, that are producing good crops.

Within recent years interest has revived and bogs are now being scientifically constructed and superintended by practical and experienced men and within the next few years the cranberry industry on the Pacific coast promises to be of considerable importance. There are probably in the neighborhood of 200 acres of new bogs which have been planted within the last two years, the greater part of which is in Pacific county, Washington, and Clatsop county, Oregon, although there are small bogs being planted all along the coast.

From the best information obtainable it is probable that there is not over 2,500 acres of good cranberry land available in the Pacific Northwest, where all the essential conditions can be found and the bogs constructed at a reasonable expense.

Requirements

Cranberry culture has always proven very profitable when properly managed and where the essential natural conditions are suitable. Most all economic plants show a preference for certain soils and other natural conditions and the cranberry is very exacting in this respect, but when once these conditions are assured there are few fruits that can be more easily and profitably grown. These conditions are well known and easily recognized by any one who will take sufficient interest to secure the literature of the subject and exercise moderately good judgment. Following are the principal requirements:

Soil

The soil should be an acid peat, free from silt or clay and also free from salt. This soil is found in fresh water marshes and is composed entirely of partly decayed vegetation. It should be at least two feet deep and is probably better if deeper. An

indication that the soil is suitable is the occurrence of wild cranberries.

Topography Drainage and Climate

The topography of the land should be such that the water can be thoroughly and easily controlled for irrigation, flooding and drainage. The land should be almost but not perfectly level in order that the bogs can be flooded and the water quickly drained off after flooding. It should have a drainage outlet with sufficient fall to thoroughly drain the land to a depth of at least four feet.

The land should be protected from high winds and storms and should have good air drainage, which will greatly aid in protecting the crops from frost.

There are only certain climates in which cranberries will produce profitable returns. The occurrence of wild cranberries is an indication that the climatic conditions are favorable.

Sand

Experience has shown that to secure the highest success and a clean lasting bog and particularly so on the Pacific coast, it is essential that there be an available supply of coarse, clean sand free from silt clay, humus or vegetation or seeds. This sand retains the heat and moisture, prevents excessive weed growth, aids in frost prevention and in combination with the peat forms an ideal soil for the plants.

Water

Without doubt the most important requirement for a profitable cranberry bog is the water supply. It is the means of insuring a profitable crop each year. It must be fresh water and there must be an abundant supply available at all times. It is used for the purpose of irrigating, flooding for frost protection, flooding for protection from insects and plant diseases and in some localities as protection from winter killing. The water supply may be secured either by gravity or by pumping. Where pumping is resorted to it is sometimes possible to drain the bogs into the source of supply and thus use the same water over several times.

Other requirements to be considered are accessibility and convenience to cities; transportation facilities, both railroad and highway; available labor supply; comfortable and healthy living conditions; storage facilities and markets.

Construction

The success of a cranberry bog will depend largely on the manner in which it is constructed, for after a bog is once

Fig. 1. Part of a Thirty-Acre Tract of O. B. Estes of Astoria, Oregon. In the foreground is the sand pit from which the bog was sanded and also the track and cars used in sanding. A large lake of about 300 acres is at the far end of the bog and is about six feet below the bog. It is intended to water from this lake for irrigation and flooding and to drain all the water back into the lake.

planted, with proper care, it will last for a long time. Bogs are known to be 40 years old. In the last few years there have been many improvements in the methods of building the bogs. It has been proven that by using the best methods the profits have been greatly increased. In Wisconsin on three classes of bogs, semi-wild, semi-clean and clean or of modern construction the average annual yields in barrels per acre were respectively 23, 46 and 94. The methods of construction will vary with the conditions.

Clearing and Preparing the Surface

A raw cranberry marsh is most always covered with a growth of trees, brush, or wild grass, which will have to be cleared and removed either by hand or machinery, depending on the character and amount of clearing.

After the land is cleared it is necessary to bring it to a uniform surface and to kill or destroy the surface vegetation. This is frequently done by scalping or removing from three to six or eight inches from the surface of the bog depending on the character of the vegetation. Scalping is done by hand or by cutters or plows drawn by horses or engines. In some cases instead of removing the scalpings they are turned over and left on the bog. Another method is to plow and cultivate the land sufficiently to kill the undesirable vegetation. The scalpings are removed from the bog by wheelbarrows or small cars. In some cases they can be piled and burned. After the bog is scalped it should be graded to a uniform surface.

Sanding

Care should be exercised in sanding the bog. The sand should be put on to a uniform depth of not less than three inches; some growers advise putting it on thicker in deep peat than in shallow peat. There are several methods used in sanding a bog. In some localities where the winters are severe the sand is hauled on to the bog with sleds and spread over the ice and when the ice melts the sand settles uniformly over the bog. Where the sand is located close to the bog it is frequently put on with wheelbarrows and often small cars are used with a portable track. Another method used and probably the cheapest where the conditions are favorable, is to pump the sand on with water and distribute it over the bog through wooden pipe. There is some question if the sand can be put on as clean by pumping as by putting it on dry.

Ditches, Dams, Dikes, Gates, Etc.

Ditches are required to drain the land in order that it can be worked, and later for the purpose of handling the water for irrigating, flooding and drainage. The same ditches can be used for all purposes to a great extent. The size and location of the ditches will depend on the amount of water to be handled. They should be of sufficient size to flood and drain the bogs within a few hours. The ditches should be at least three feet deep and in

Fig. 2. Planting of Prolifics from Wisconsin on Newly Constructed Bogs. Indicates also method of ditching.

Fig. 3. This Picture Shows a Year-Old Bog. On the near side of the ditch and on the other side is a newly planted bog in which all the ditches have not been dug. This bog belongs to Mr. Schimpff of Astoria and contains ten acres.

some cases deeper. It is sometimes necessary to dig large ditches several miles in length in order to secure drainage. The small ditches are usually dug by hand and some of the larger ditches by small dredges.

Dams and dikes will be necessary along the ditches in order to control the water when flooding. These can be constructed when the ditches are being dug and they are sometimes built with the scalpings from the bog.

In order to control the water for irrigating and drainage it will be necessary to construct gates and flumes in the ditches. The number and location of these will depend on the arrangement of the bogs. They are mostly built of wood, but in some cases the more important may be of concrete or steel pipe.

Water Supply

The water supply may be secured from living streams, storage reservoirs, lakes, or it may be pumped from wells into a reservoir. In some places it is necessary to control large areas of land in order to secure sufficient water. It is sometimes necessary to carry water long distances in canals or ditches. The distributing system should be so arranged that the bogs can be flooded in five or six hours and drained off in two hours. The design of the water system will also depend on whether the water is to be used for flooding or just for irrigating or for both. Where there is sufficient water of the proper character a gravity system will be the best. As there are few places where sufficient water can be secured by gravity it is probable that most bogs will have to depend on pumping plants. The pumps can generally be operated at a very low cost and in most cases will be more economical than a gravity system.

Buildings and Equipment

The buildings required will consist of some dwellings or living quarters for the superintendent, laborers and harvesters; some tool sheds and a packing and storehouse. The storehouse should be so arranged that it can be kept at a uniform temperature and dry and should also be arranged so that it will have good ventilation and that the sunlight will not strike the stored berries. The packing and storehouses should be built and operated by an association of the growers. These buildings are mostly built of wood, but recently the larger companies are building them of concrete or brick.

The machinery and equipment required will consist of some machinery for clear-

ing, scalping and sanding the bogs during the construction period. For the operation of the bogs after they are in bearing about the only equipment required will be spraying outfits; cleaning, grading, packing and sorting machinery; instruments for weather observations, equipment for conveying the berries from the bog to the storehouse and unless the water is secured by gravity, a pumping plant will be required. The greater part of this equipment should be owned and controlled by an association of the growers.

Plants and Planting

Cranberry bogs are established by planting cuttings from old vines. These cuttings should be from eight to ten inches long and are generally planted by forcing the middle of the vine down through the sand into the peat leaving the tow ends of the cuttings sticking up above the surface of the sand. From each of these cuttings runners grow along the surface of the sand and gradually form a thick mat of vines over the entire bog. The vines are generally planted in the spring, but in the Northwest they can be planted during the fall and winter.

There are a great many varieties of vines, but the grower need not consider over a dozen varieties. In selecting the varieties care should be exercised as to whether they are early or late, their keeping qualities, color, size and yield. The principal varieties now grown on this coast are the McFarlan and Early Blacks. The vines now being planted are practically all imported from the East, mostly from Massachusetts. Some of the Massachusetts varieties are Early Black, Howe, Centennial, Bugle, McFarlan, Mathews and Batchelder. Some of the Wisconsin varieties are Prolific, Searles Jumbo, McFarlan, Bennett Jumbo, Metallic Bell, Palmeter and Howe. The only varieties planted from Wisconsin on this coast are the Searles Jumbo, Bennet Jumbo, and Prolific. The vines are planted about ten inches apart and it takes about 700 pounds to the acre.

Developing the Bog

After the bog has been planted it will be at least three years before there is a paying crop and during this time the bog will require considerable attention. The principal work during this time will be to keep the bog free from weeds and to control the irrigation and drainage in order to get the proper growth of vines. It will also be necessary to guard against insects and plant diseases.

Fig. 4. Children Planting Cranberry Vines.

Fig. 5. Vines Planted May, 1912; Picture Taken September, 1912.

Production and Disposal

There will be no cultivation as in many other plants while producing a crop, but there will be some weeding and the ditches and dams will have to be kept clean and there will probably be some spraying required to prevent insects and diseases.

The water and drainage will have to be carefully looked after as the quality and yield of the crop will depend greatly on the control of the water. At times it may be necessary to flood the bogs in order to protect them from frost, insect and plant diseases. It may be found advisable to re-sand the bogs to a depth of from one-quarter to one-half inch every three or four years. After the crop has been harvasted the vines should be pruned. This keeps the bog in better shape for scooping and also benefits the quality and yield of the berries. Harvesting generally lasts three or four weeks during the later part of August and September. The berries are generally picked before they are fully ripe and allowed to ripen in the storehouse. They are harvested either by hand picking on the younger vines or by scooping on the older bogs.

After the berries are harvested they are taken to the packing houses where they are cleaned, sorted, graded and packed in barrels or boxes and then stored until time for shipment to the dealers.

At present practically all the berries are sold as fresh fruit, but there is an unlimited opportunity to increase the consumption by canning and evaporating them which is done at present to a very limited extent.

The total production of cranberries in the United States is about 500,000 barrels annually which is only about one pint per capita for the United States. It is considered that the cranberry industry is only in its infancy.

Enemies and Hinderances

Like all other organisms the cranberry has its enemies and diseases as well as other hinderances, but by proper care and management these enemies and hinderances can be controlled or prevented. By flooding or spraying the grower can protect his crops from insects and diseases and by flooding can prevent loss from frost. He can also control weed growth. Wind, rain, hail, and extreme heat and cold are elements over which he has no control, but can be avoided to a great extent by choosing a location where the damage from these sources will be very light.

References to Literature

On account of lack of space it has been impossible to go into much detail regarding the various parts of cranberry culture, but by reference to the publications hereafter listed more detailed information can be secured.

Books Published

"Cranberry Culture," by J. J. White.

"Cranberry Culture on a Western Plan," by Augustus G. Gray.

U. S. Department of Agriculture Publications

Farmers Bulletin No. 176, "Cranberry Culture," by L. C. Corbett.

Farmers Bulletin No. 178, "Insects Injurious in Cranberry Culture," by John B. Smith.

Farmers Bulletin No. 221, "Fungus Diseases of the Cranberry," by L. C. Shear.

Farmers Bulletin No. 227, "Experiment Station Work."

Wisconsin Agricultural Experiment Station Bulletins

No. 119, "Reports on Cranberry Investigation."

No. 159, "The Cranberry Insects of Wisconsin," by C. B. Hardenberg.

"Cranberry Bog Construction," by O. G. Malde.

"Cranberry Bog Management," by O. G. Malde.

Also the annual reports of the Wisconsin Experiment Station.

Bulletin No. 86, West Virginia Agricultural Experiment Station, "Cranberries in West Virginia," by L. C. Corbett.

Special Bulletin K of New Jersey Agricultural Experiment Station, "Insects Injuriously Affecting Cranberries," by John B. Smith.

The Annual Reports of the Cape Cod Cranberry Growers Association.

The Annual Reports of the Wisconsin State Cranberry Growers Association.

The Annual Reports of the New Jersey Cranberry Growers Association.

The only periodical devoting space regularly to the cranberry industry is the Wareham Courier, Wareham, Massachusetts. It is published each week.

Bureau of Plant Industry Bulletin No. 193, "Experiments in Blueberry Culture," by Frederick V. Coville, would also be of interest as the blueberry and cranberry are in many ways similar as to natural requirements.

CRANBERRY DISEASES

The fungus and other troubles of cranberries are not so numerous as in the case of some other fruits. The Depart-

Fig. 6. Part of a Bog Planted May, 1912. Planted with Searles Jumbo vines from Wisconsin. Vines one year old at the time the photo was taken.

ment of Agriculture has conducted some investigation as well as the Wisconsin Experiment Station. The results are embodied in what follows.

Cranberry Anthracnose

Gloeosporium Sp.

Cranberry anthracnose seems to be most common in Massachusetts and New England cranberry bogs. It closely resembles the species so injurious to the apple and other fruits. The appearance of the disease upon the fruits is similar to that of scald and rot, and can only be distinguished certainly by microscopic examination.

Cranberry Blast

Guinardia Sp.

Cranberry blast is a name given to that form of the disease which attacks the very young fruits as soon as the blossoms fall. It causes the fruit to shrivel up, become black, and finally become covered with one of the spore-producing forms of the fungus, which is a species of *Guignardia*, very closely related to the species which produces the black rot of the grape. The spores produced upon these young berries are the probable source of infection of most of the other fruit. This fungus produces two kinds of fruit, or, in other words, passes through two stages of development. The earliest stage produces its spores in small black spherical receptacles. This fruiting form of the fungus is the most abundant, and it is probably from this source that most of the leaves and fruits are infected. The second stage in the development of the fungus is that in which the spores are produced in sacs. These are inclosed in receptacles as in the other stage mentioned.

Blight

This trouble has appeared on Wisconsin bogs as a dying of blossoms and very small fruit just at the time of setting. It is sometimes attributed to hot weather. Investigations at the Wisconsin station, however, seem to disprove this theory. As yet no specific cause has been worked out. If the vines are kept in a vigorous and thrifty condition the trouble seems to be largely avoided.

Cranberry Rot

Cranberry rot has until recently been confused with and attributed to the same cause as the scald. Its effect upon the berry is very similar to that of the scald fungus. It is produced, however, by a quite different species of parasite, though belonging to the same large group known as the "black fungi." In some cases where the fruit is in an advanced stage of the disease, the presence of the fungus is indicated by irregular black blotches just beneath the skin of the diseased portion.

Cranberry Scald

The name "scald" originated as a result of the belief formerly prevalent among cranberry growers that the injury was due to the effect of the hot sun upon the berries when they were wet, thus producing what was regarded as a real scalding of the tissues of the fruit. Fruit which has been overflowed for a half day or more during hot weather may be injured as a result, and the effect in many instances closely resembles that produced by the scald fungus. A microscopic examination of the berries shows at once the difference. In the berry which has been affected by being covered with water no fungous threads or filaments can be found, whereas in the case of the berry attacked by the scald fungus an abundance of such filaments may readily be observed in the pulp of the diseased berry. Only in the rarest instances does the scald fungus fruit on the berries after they have become half grown.

The disease first becomes noticeable as a small light-colored softened spot on the surface of the berry. This spot rapidly increases in circumference and finally envelops the whole fruit. Sometimes the diseased portion shows more or less distinct brownish zones. In other cases the zones are lacking and the whole fruit becomes very soft and has a light watery color. In many instances it is very difficult to tell from the external appearance only whether the disease is due to the scald fungus or the rot fungus.

Remedies and Treatment

Only preventive measures are available at present in combating these diseases. After the parasites have once entered the tissues of the plant they are practically beyond the reach of remedies. Hence, efforts must be devoted to protecting the plants and keeping them in the maximum condition of health and vigor, as in this condition they are most capable of resisting disease.

It has been frequently noticed that the plants on certain cranberry meadows and portions of meadows suffer much more from rot and scald than others. This is no doubt due in great part, in many cases at least, to the soil and water conditions under which the plants are growing. From personal observations and the experiences of growers it is the opinion of the writer that in the majority of cases the control of the water supply is the most important single factor.

Water Supply

Just what the best quantity of water is and the best way to distribute it can only be determined in each case depending upon the nature of the soil, subsoil, contour and drainage of the land. In general it may be said that the water supply should be so controlled as to avoid any great fluctuations in the quantity supplied to the plants during the growing season. The cranberry is by nature a water loving plant, and seems to suffer more frequently from a lack of water than from an excess.

Destruction of Dead Vines

All dead vines and leaves should be destroyed. Frequently small areas of vines die, apparently from the attacks of the cranberry fungi. All such vines should be pulled or cut and collected early in the spring, at least within two weeks after the water has been drawn from the bog, and burned. Vines which have been cut in raking bogs to prepare them for scooping should also be treated in the same manner. Such vines if not destroyed invariably produce the spores of the cranberry fungi in great quantities and are a fertile source of infection for the young leaves and fruit. Little is to be feared from the rotten berries which have reached maturity, as the fungi very rarely produce any spores on such berries.

Disease-Resistant Plants

It is a matter of common observation among growers that some varieties rot or scald worse than others. Hence, in setting new bogs or replanting old ones the most hardy varieties should be used. By giving careful attention to the selection of disease-resistant plants for propagation, a practically immune variety can probably be eventually secured.

Fungicides

The Bordeaux mixture has proved the most efficient of any fungicide used.

Satisfactory results from spraying can be secured only by exercising great care and thoroughness in the preparation and application of the mixture.

Preparation of Bordeaux Mixture

Bordeaux mixture should be prepared as follows:

Copper sulphate (blue vitriol or bluestone)	6 pounds
Unslaked stone lime	4 pounds
Water	50 gallons

Soap for Use with Bordeaux Mixture

To complete the mixture for effective use in treating cranberry diseases, it is necessary to add something to cause it to spread evenly and adhere to the foliage and fruit, whose smooth, glossy surface causes the plain Bordeaux mixture to either collect in drops or run off entirely. Several soaps have been tried for this purpose, of which resin-fish oil soap has proved the best. This is prepared as follows:

Resin	5 pounds
Potash lye, such as is ordinarily sold for washing purposes	1 pound
Fish oil	1 pint
Water	5 gallons

Dissolve the resin with the oil in a large iron kettle. Let this cool somewhat and then add the potash, slowly stirring the mixture at the same time and watching it carefully to avoid its boiling over. Then add a part of the five gallons of water and continue boiling until the mixture will dissolve in cold water. This will require about one hour, when the remainder of the water should be added slowly and the whole thoroughly stirred.

Literature

Farmers' Bulletin No. 221.

Wisconsin Experiment Station Bulletin No. 219.

CRANBERRY PESTS

Comparatively little new work on cranberry insects seems to have been done since that of Professor J. B. Smith, of the New Jersey station, the chief results of which were published by the department of agriculture in 1903. Malde, of the University of Wisconsin, has done some work along the same line. Professor Smith is the main authority for notes on cranberry pests embodied in this work.

Blackhead Cranberry Worm

Eudemis vacciniana Pack.

This is perhaps the best known and most uniformly injurious of all cranberry insects and is locally known as the "vine worm" in Massachusetts and as the "fireworm" in New Jersey. As a larva (worm) it is a deep, rather velvety, green, slender little caterpillar, not over half an inch long when full grown, and with a shining black head and neck. The adult is a small moth or "miller" with narrow, dusty-brown wings that measure less than half an inch when expanded and seem much smaller because they are so slight.

The moths first appear on the bogs in early June, continuing until nearly the end of the month, and again late in July, continuing into August, when they disappear for the season. During the day little is seen of them. In the early evening and until the darkness sets in fully they are on the wing and hover a short distance above the plants.

Before the end of August, they have left, scattered everywhere on the undersides of the leaves, their minute yellow eggs. There they remain throughout the winter, whether the bog be dry or flowed, and the little caterpillars hatch from them in spring. For a day or two the worms nibble on the under surface of the old leaves or may even burrow into them and then make their way to the tip of an upright, where they spin together the edges of the new leaves.

In about three weeks from the date of hatching, the caterpillar is full grown, lines the inside of its shelter more fully and closely with fine silk, and changes to a stubby little yellowish-brown pupa. In a week the transformation is completed and the moth appears about the first of July. The bog at the beginning of July shows very plainly the effects of the insect's attack in brown tips that are everywhere noticeable; and every brown tip at this time means a barren upright.

The second brood which soon appears is more destructive than the first for the reason that they extend their operations farther and the fruit is coming on at that time. They damage the fruit all out of proportion to the food consumed by nibbling here and there on fruits and foliage until the entire bog may have a burnt-over appearance. Hence the term "fire worm," as applied to this species.

There is another brood by the middle of July but the great damage has been done by the second brood.

Yellowhead Cranberry Worm

Teras minuta Rob.

This insect is much more abundant in New Jersey than it is in Massachusetts, and in some localities in the latter state it does not seem to occur as a cranberry feeder at all. It is quite as plentiful on Long Island as it is in New Jersey, and wherever it occurs is apt to be even more injurious than the preceding species.

Life History

The life histories of these two species differ in that, in the case of the yellowhead, the moths hibernate during the winter, come out and lay their eggs during April and May and disappear. The larvae appear a week or ten days later and in feeding spin the leaves together as in the case of the preceding species. The first brood of moths appear in late May or early June. They are bright orange red, while the earlier brood is slate gray. The second lot of eggs hatch in late June, and, early in July, when the cranberries are in full bloom, the larvae are half grown and doing their greatest damage. They pupate about July 15. The pupa is distinguished by a nob on its head. The next brood is not so injurious.

Remedial Measures

Flowing the Bog

The application of insecticides on large bog areas where the plants cover the ground as densely as do the cranberry vines is a task no grower likes to contemplate; and provided he has control of a satisfactory amount of water there is no necessity for it. As against the "yellowhead" (Teras), it will suffice if the water be held on the bogs until the middle of May, or perhaps a little later in cold seasons. This will compel the moths to seek other plants upon which to lay their eggs.

As against the blackhead late holding will not of itself suffice, because the eggs are already on the plants and will, under ordinary circumstances, hatch only under the same conditions that favor the start of vines themselves. But there is a little leeway in favor of the plants and the eggs do hatch under water at a temperature not quite sufficient to start the vines.

Carefully carried out, this measure is often very effective; the warmth favors the development of the embryo within the egg, and when the worm hatches it drowns.

Reflowing

When the supply of water is abundant above the bog area, so that a pond or reservoir may be formed, both the yellow and blackheads may be completely controlled by drawing the water early, waiting until all the eggs have hatched and some of the worms are nearly half grown, and then re-covering the bog with water for 48 hours. This method is so simple and so absolutely effective that the larger growers are adopting it almost universally, and few new bogs are laid out anywhere without considering the matter of reflowage and providing for as good a control of the water as possible. Covering the bogs should begin in the late afternoon and should be completed before next morning, if possible. On a rainy day it may begin at any time, the object being merely to prevent the sun from boiling the young shoots. So drawing off the water should also begin in the early afternoon, and the bog should be practically dry the morning after. Incidentally, this reflowing will rid the bog of numerous other pests and may make a material impression on the girdle worm where that is abundant.

Insecticides

Sometimes it happens that bogs can be neither winter flowed nor reflowed, and the application of insecticides becomes an absolute necessity. Only arsenites are to be relied upon for good results. It follows from what has been said concerning the habits of the worms that when once they have spun up the tips and are feeding in their cases they are practically beyond the reach of our common insecticides; and that is particularly true of the first brood. If there is reason to believe from past experience, or because eggs have been found on the plants, that the early brood will be numerous, spraying must be done just as soon as the vines make a start or not later than the date when the first spun-up tip is seen.

All things considered, the best insecticide for use on cranberry bogs is arsenate of lead.

FIRE WORM. See *Blackhead Cranberry Worm.*

Cranberry Fruit Worm

Mineola vaccinii Riley

Bogs that cannot be reflowed and high and sandy bogs suffer most from this insect.

The adult moth appears on bogs in ordinary seasons about the middle of July, when the berries are setting or have already set.

The moth, with wings expanded, measures about three-fourths of an inch and is of a glistening ash-gray, mottled with white and blackish. It is a shy species, not easily started during the day, and flies with a darting motion for quite long distances. It is not generally recognized, therefore, even by growers who annually lose heavily by it. When at rest the wings are folded close to the body, and on a cranberry stem, where it usually rests head down, it is not readily seen even by an experienced eye.

The eggs are laid on the young berry, preferably in the calyx, just beneath one

of the lobes, but they may be on any part of the berry and possibly on the leaves as well. The worms emerge in about five days, and for a day or two feed on the outer side of the berry. Then each worm enters a berry, eats out the seed chamber, and migrates to another. The vacated berry turns red, shrivels up, and eventually drops. In this second berry it becomes half grown, then works out through a large jagged opening and gets into a third berry. By this time the season is pretty well advanced, the fruit is of good size, and, soon after the worm starts feeding, the newly infested berry begins to turn red. To the ordinary observer the fruit is ripening nicely, if early; but the grower knows better and realizes that every such specimen is lost to him. Quite frequently the worms do not get their full growth at picking time, and emerge from the berries after they are harvested. These delayed forms make their way to any crevice or other shelter that they can find and there spin up for the winter rest.

At this time the worm is rather more than half an inch in length, of a bright green color, with a variably marked reddish tinge on the back.

The full-grown caterpillars winter in their silken cocoons, which they make by first rolling in the sand, gluing the particles together with saliva, and then spinning their web inside of the rough casing so formed.

Remedial Measures

Winter flowage is not fatal to these insects, and covering the bogs with water at any time after the winter cocoon has been formed would probably be ineffective. Nevertheless, water-covered bogs are less troubled, and it is probable that the earlier the water is put on in the fall the more effective this practice will be.

Indications are that if a bog can be safely submerged for 48 hours between August 10th and 15th, just before the worms reach their full growth, the great majority will be killed off. Sound berries covered for that length of time will not come to harm if the water can be put on and drawn off rapidly enough to avoid scalding. Fruits not quite so far advanced may be covered for even a longer time without injury. The vines should be completely covered before the sun beats upon them high enough to warm the water, the covering should be sufficiently deep to prevent a scalding effect, and when the water is drawn sunrise should find at least every berry above the water level, that the drying off may be gradual. A cool day would almost insure safety to the berries, an intensely hot one might cause injury, and the nearer maturity the fruit the greater the danger.

If reflowage be not practiced, pick the crop as soon as it is at all practicable, so as to get as many wormy berries off the bog as may be. The worms will emerge in the cranberry house and form their cocoons in cracks and crevices or among rubbish. Give them plenty of shelter in the way of loosely piled slats, boards, or other cover, placed wherever conveniently possible, and any time during the winter clean up thoroughly, so as to reach the hibernating worms. Field mice will eat these worms. Also a liberal use of gasoline in such places under the usual precautions against fire would reach every one of them.

Insecticides are possible only during the two or three days in which the young worm feeds on the outside of the berry, and the only material that offers any chance of good results is arsenate of lead. One spraying per week for three, or preferably four, weeks offers a fair chance of success by killing off the berry worms before they get into the berry.

On bogs that cannot be flowed the arsenate of lead, aided by early picking, will probably reduce the amount of injury materially; but on such bogs the development of the moths may occur earlier and the grower must rely more upon the stage of growth, or, better, the appearance of the moths themselves on the bog, than upon any absolute dates.

Cranberry Girdler

Crambus hortuellus Hbn.

This species, more commonly known as the "girdle worm," is found abundantly in all the cranberry districts, but it is seriously injurious in Massachusetts only. The

larvae, which are slender, grayish caterpillars, with shining, light chestnut-brown heads, and yellowish thoracic shields, pass the winter in a torpid condition within a silken tube or cocoon, which resists the entrance of water. In New Jersey the adults are found in May; in Massachusetts they do not fly until July. The change to the pupa takes place in the tube or cocoon made in the previous fall, and on Cape Cod at the latter part of May or in early June. The adult is a pretty little creature, with forewings expanding about three-fifths of an inch, and is one of the long-snouted moths, the palpi or mouth feelers projecting well beyond the head. The forewings are rather narrow and very pale straw-yellow in color. The hind-wings are much broader and of a uniform silvery gray. When the moth is at rest the wings are so closely wrapped around the body that it looks like a narrow whitish cylinder about three-quarters of an inch in length

The young worm is very active and strong, and at once begins the construction of the silken tube, re-enforced by bits of vegetation, in which it lives. It works about the running portion of the plants extending along the surface of the sand in the stratum of fallen leaves which always cover an old cranberry bog and from which the delicate clusters of new rootlets take their rise. Everywhere over an infested area, but especially along its borders, these worms can be found in filmy silken galleries following the prostrate stems of runners, into the surface of which they eat their way, destroying the vital part of the plant and, especially next to the base of the runners, deeply girdling the stem. They grow rather slowly, and not until November do they make their coarse cocoon of mingled sand and silk that serves as winter quarters.

An infested bog is rarely affected over its entire extent. Small areas varying from a few feet in diameter to half an acre or more are found here and there, and sometimes a little patch only a foot or two across will remain for two or three years in succession without becoming enlarged, but rather it will become closed up by runners from the adjacent healthy vines.

Remedial Measures

It is quite obvious that insecticides are not available here, because of the concealed feeding habit, and that resort must be had to more direct methods. But the insect does not make this cocoon until November, and a submergence of five days immediately after the picking is completed destroys a great many. The suggestion is therefore made that, immediately after the fruit is off, infested bogs be flowed and be kept covered for at least a week, and better two weeks. While the ripening fruit is on, any water covering kept on over 24 hours would be apt to do material injury.

An additional suggestion is that the actually infested area be completely burned off as soon as its extent can be determined. For this burning a gasoline torch may be employed, and the heat thus applied directly to the point where it will be most effective. The burned-over area can be immediately reset and the actual amount of injury limited to a minimum.

Cranberry Katydid
Scudderia texensis Sauss.

One of the most destructive insects on the New Jersey bogs is a species of katydid, though its injuries, as a rule are charged to grasshoppers in general.

The injury is chiefly caused by the feeding habits of the adult of one species of katydid which chews into the berries when half to full grown, rejects the pulp, and eats the seeds. The injured berries wilt, shrivel, and die; but when they have just been left by the katydids, the common, shorthorned grasshoppers feed on the exposed pulp and, being detected in this, are quite generally charged with having caused the entire trouble. One katydid may eat out several berries at one sitting, and when the insects are at all abundant the percentage of fruit destroyed is very large; on some bogs the amount reaches almost or quite one-half the entire crop.

The katydids when mature are green, grasshopper-like insects, with very long

antennae, or feelers, and long slender hind legs.

The eggs are laid chiefly in two kinds of grasses, locally known as "deer grass" and "double-seeded millet." Occasionally eggs are laid on other grasses or plants, but never on cranberry leaves.

Remedial Measures

The character of the remedy to be adopted follows from the egg-laying habits of the species. Allow none of the host grasses to maintain themselves on the bogs and burn over the dams during the winter while the bogs are flowed. From the fact that the very young katydids are never found on flowed bogs except at the edges joining the upland or at the base of the dams, it may be fairly inferred that the eggs do not survive the winter when kept completely submerged, so that destruction of the grasses above the water line might answer. It would be safer, however, to have the grasses out; they have no place on the bogs anyway.

For burning the grasses and other host plants on the dams some one of the gasoline torches now on the market may be used. They give a very intense heat and lick up leaves and plants with extreme rapidity. As they can be used against the wind or while the plants are somewhat damp there is practically no danger that the fire will get away, and when the ground is frozen, the covering of leaves and stalks is burned so rapidly that no heat gets to the roots.

Grasshoppers and Crickets

Numerous short-horned and long-horned grasshoppers may be found on and about the bogs, and more or less injury is charged to them. As to the common gray or brown short-horned grasshoppers the charge is believed to be practically unfounded. They do sometimes finish up berries that have been opened by the katydids; but direct evidence is lacking that they would or even could get into a sound berry. Nor do they occur in any numbers on clean, well-kept bogs, free from grass and overgrown edges or dams. They belong naturally in the grassy undergrowth along the margins, and simply run over when there is an easy opportunity.

It is rather otherwise with some of the long-horned, green, meadow grasshoppers, which on grassy, reedy, or sedgy bogs are sometimes present in immense numbers. All of these are fond of seeds, and while the smaller species cannot get into a half or full grown berry, the larger species can, and so they join the katydids in their destructive work, but in comparison do little injury.

Most of them have a long, flat ovipositor, straight or slightly curved, and they lay their eggs in the stems of the sedges, rushes, and larger grasses found on the bogs. None of these species can cut into leaves. Their eggs are long, slender, nearly cylindrical, and often just a little curved. They are laid in series of anywhere from three to eight, one above the other, the number of eggs in any series depending upon the length of the ovipositor in the species.

Where bogs are very full of these little species, a large proportion of the grasses and sedgy plants will be found bearing eggs, and these eggs are so well protected that they survive the winter though they be completely submerged. Accordingly, in early June thousands of the little meadow grasshoppers are found just hatched and under such conditions that they could not possibly have come on from the outside.

Remedial Measures

The only way to keep these species off the bogs is to keep down the grasses. They are not naturally feeders upon the cranberry plant, and exact so small a toll that the actual loss is less than the probable cost of getting rid of them. If the grasses, etc., cannot be readily taken from the bogs, they might be mowed, after picking, above the vine level. This would cut off the parts bearing the eggs, and as the loose grass would float when the water is put on, the eggs would either be carried to the edges or would decay with the vegetation containing them.

Crickets also occur in greater or less numbers on most bogs, and growers are by no means agreed whether they cause injury or not. That they will eat berries

on the ground, especially under cranberry crates, is certain; but it is not proved that they ever go upon a vine to feed upon a berry attached to it. The species lay their eggs in sandy soil, and never in wet or mud land; so, as a matter of fact, no field crickets can really propagate on the bogs. But they get into the dams, and oviposit in warm sandy places, so that the young may hatch early in the spring and find their way to the moist, warm places in which they delight. Their range of food seems to be wide, and there is almost nothing they will not eat under favorable conditions; but they live on the ground and rarely get out of the shelter of the vines or upon them.

If it be deemed desirable the crickets can be kept off the bogs almost entirely by broad, clean, marginal ditches maintained at least partly full of water. The crickets rarely if ever fly, and, while they are good swimmers, do not ordinarily attempt to cross any ditch six feet wide.

A flowing just after picking would destroy most of the grasshopper and cricket tribe that then occur in their greatest number.

MEASURING WORM. See *Cranberry Span Worm.*

Cranberry Span Worm
Cleora pampinaria Gn.

In some sections of Cape Cod certain "span," "inch," or "measuring" worms occasionally become injuriously abundant and the most destructive of these is the species above named. The color of the parent moth is pale ash gray, sprinkled with black, and both wings are crossed diagonally by black lines and shades. The worms first appear on the bogs in June and become fully grown by the end of that month or early in July. They are then rather more than an inch long; slender, smooth, livid gray caterpillars with deeply indented head and long, pointed anal plate.

When full grown they bury themselves in the ground and pupate. The moths emerge a few days later. The second brood comes on in early August and pupates before the tenth. The moths appear late in August and September.

There seems to be no regularity about the appearance of these insects. Some years they do not appear at all. In others they appear in great numbers and occasionally in armies.

Remedial Measures

Being an open feeder upon the foliage, this span worm is susceptible to arsenical poisoning, and unless the bogs can be rapidly reflowed and as rapidly laid dry, spraying or dusting are the only alternatives. Where the worms are noticed when they first start, spraying the foliage just ahead of them may answer all purposes, and indeed this poisoning of their line of advance should always be done before treating the parts already infested. Either Paris green or arsenate of lead may be applied.

Cranberry Tip Worm
Cecidomyia oxycoccana Johns

This is a minute orange-red or yellowish grub about one-sixteenth of an inch in length, found in the growing shoots, whether uprights or runners. It appears on the vines soon after they make a start, and the first indication of its presence is when the small leaves of the tip cease to unfold and become bunched into a compact, bulb-like mass. When this mass is opened, from one to five, and usually two or three, of the little grubs will be found at the very heart of the growing tip, feeding upon the juices and completely checking growth. If it is a runner that is attacked, it is destroyed; if a fruit-bearing upright, the flower buds come out below the infested tip and no harm is done to the crop. But the insects continue to appear on the bogs at intervals throughout the season, and the danger is that the late-tipped uprights will form no fruit buds for the next year.

The adult is a minute, two-winged fly or midge whose wings when expanded measure less than an eighth of an inch from tip to tip. The male is quite uniformly yellowish-gray and inconspicuous, but the female has the abdomen deep red, the upper surface of the body gray, the sides yellowish, the head and eyes black. She also has a slender, extensile tip to the

abdomen, by means of which the minute white eggs are laid in the very heart of the bud.

Remedial Measures

Strictly speaking, no direct remedial measures are known. It is not known positively how the insect passes the winter; hence control can not be attempted at that season. The worm never comes within reach of our ordinary insecticides, and therefore direct attack is not possible. Since the loss of the tips attacked in spring does not injure the crop of that year, the effort must be to keep the vines in such vigor that they will set fruit buds on laterals and at leaf axils when the direct tip has been lost.

This insect is not confined to the cranberry, and in fact breeds much more abundantly on loose strife (*Lysimacha*) and on some of the heaths. Therefore, where the species is troublesome, those plants should be kept down on the dams and other bog surroundings.

VINE WORM. See *Yellowhead Cranberry Worm.*

Cress

The word cress, when applied to plants, refers to any one of several species mostly of the mustard family *Cruciferae.* It has generally a pungent taste and is used in salads.

The common cresses are the English water cress; the American water cress; common garden cress and the Indian cress. The water cress is an aquatic plant, with long stems, which readily take root in water or very moist soil. It is therefore generally grown along the edges of streams, ponds, ditches, or other places, where it grows partly in the water and partly out. But it may be cultivated by the digging of trenches or small ditches, where the water may be turned on at pleasure.

GRANVILLE LOWTHER

CRESS PESTS

Water Cress Leaf Beetle

Phaedon aeruginosa Suffr.

Attacks the under side of the leaves and the stems, eating off the cuticle.

The beetles are less than an eighth of an inch long and "shiny, bronzy black." Both the adult and larva are injurious.

They probably range from Massachusetts to West Virginia.

Growing the cress in running water which carries the bugs away, or flooding for the same purpose are the best remedies thus far discovered.

Literature

Bureau of Entomology Bulletin 66.

Water Cress Sowbug

Mancasellus brachyurus Harger

This pest has been troublesome in Virginia, West Virginia, and Pennsylvania, where cress is grown commercially.

This creature is not a bug but belongs to the same order as the crayfish. It differs somewhat in appearance from the common dooryard sowbug though similar in general features. The water cress sowbug is "decidedly shrimplike" in appearance, gray in color and when full grown about a half inch long.

The only method of control which seems to have worked successfully so far is that of special construction of the cress beds.

The beds are constructed sixteen feet wide with a general slope of about three inches to the 100 feet and graded toward the center, through which, running lengthwise of the bed, is placed a square trough made of three ten inch boards. When it is desired to get rid of the bugs the water is shut off from the bed and drained out through this central trough. The bugs follow the receding water and so are caught in the trough. After the water is well out of the trough the bugs are killed with bluestone. The water is kept off the bed for twenty-four hours to kill the bugs which remain in the cress.

Literature

Bureau of Entomology Bulletin 66.

CROPPING, PREPARATORY. See *Preparation of Ground* under *Apple Orchard.*

Cucumbers

Cucumis Sativus

Long Green Cucumber.

The cucumber is a well known fruit, grown in all parts of the civilized world, and cultivated from very early times. It is supposed to have been cultivated in the days of Moses, and mentioned in Numbers XI: 5. Alphonso de Condolle affirms that the cucumber was cultivated in India 3,000 years ago. The plant is an annual trailing vine, with stalked hairy leaves, and tendrils by means of which the plant can be trained to supports. There are a large number of varieties which may be classified under two general heads as follows:

First. Forcing or hot house varieties.

Second. Outdoor or field varieties.

The "forcing varieties," are started in hot houses or hot beds, and later may be transplanted to the open air, or the growth continued under glass for winter use.

The outdoor varieties are planted in hills, about six feet apart, six or eight seeds to the hill and then thinned to two or three after they are fairly started, and the strongest plants left for further development. When the vines are about two feet long, some growers pinch off the tops so that the vine will put out lateral shoots and bear a heavier crop. The flowers are pollenized by insects, and the varieties will mix by interpollination.

Soil Best Adapted

The cucumber will do fairly well on almost any soil that will grow corn, wheat or oats; but it does best on deep, rich loam. When the ground is warm and well prepared, it may be planted as early in the spring as the time when danger of frost is past; and the seed covered about one inch deep. There are no special directions necessary; for the cucumber is so common that almost every one knows something of its habits of growth.

Picking

The time for picking cucumbers depends on the uses to which they are to be applied. If grown for pickles, they are picked when about three inches long. The whole area should be gone over every second day and all of the required size carefully removed from the vines, cutting the stem about a quarter to half an inch from the cucumber. Care should be exercised to see that the pickers do not bruise the vines by tramping upon them, or the crop will be injured.

If cucumbers are meant for table use, they may be allowed to grow to considerable size, say six inches in length, provided that they should not be allowed to

approach too nearly the ripening period when the surface skin begins to turn yellow.

Certain vines may be selected to produce seed, in which case they should not be disturbed by the picking process, except to train the vine to produce the largest and best specimens. As soon as the seed is ripened the plants begin to die.

Varieties

If cucumbers are planted for pickles, the varieties producing the largest number of small fruits, rather than a few large ones is preferable. For this purpose the variety known as the Boston Pickling is highly recommended. For general home use the White Spine is good. Other varieties are the Cumberland, Thorburn and Fordhook Pickling.

GRANVILLE LOWTHER

Cucumbers in the South

W. P. WILLIAMS

Cucumbers can be made a very profitable crop in all sections where they can be raised early, and shipped to Northern markets.

After the land has been prepared, the best way to fit it for the crop is to plow out furrows with a single shovel cultivator, or a bull tongue, and in this furrow put the fertilizer, and with a narrow cultivator thoroughly mix this with the soil. Then with a sweep or cultivator, level the soil into this furrow, and then drill in the seed.

The rows are made five or six feet apart, and after the plants are up, they are thinned to about one foot in a row. The seed are sown in the southern part of the Gulf states from March 1st to the 15th, some risk being taken at this time as there are occasional killing frosts this late. Providing the crop is not injured by frost, a few days gain on the market makes a considerable addition to the profits obtained.

Cultivation is given the cucumber similar to that of other crops. Frequent but shallow cultivation is practiced, care being taken not to disturb the vines more than necessary. The soil is ridged slightly to the row so as to allow surface water to run off quickly. Cucumbers require a quick steady growth and thus the land must be sandy so as to give the best action for fertilizers.

The best fertilizer found in this section consists of 7-4-8 goods, using about 700 to 1,000 pounds per acre, and made up as follows:

	lbs
Acid Phosphate, 16 per cent	395
Cotton Seed Meal	286
Nitrate of Soda......................	125
Muriate of Potash	194
	1,000

The nitrogen should be obtained from some compound where it is easily available, as in dried blood. The above formula is put under the plant, and when the latter has developed the fourth leaf a top dressing of about 75 lbs. of nitrate of soda is given, and about the time the blossoms fall, another dressing of 75 lbs. is applied.

The cucumbers are picked when about eight inches long, and packed in hampers or crates. The harvesting in this section begins about June 1st to the 15th, varying a little with the season. The hampers or crates are put in refrigerator cars, there being about 300 to 500 per car. These cars are shipped to various northern markets, as Chicago, Cincinnati, St. Louis and Detroit.

The varieties most commonly grown are Davis Perfect, Long Green and Klondike. The market requires a long slender cucumber, with very small and few seeds, and the above varieties produce cucumbers of this description.

Yields run from 250 to 400 hampers per acre, and prices from 40c to $1.00 per hamper. The outlook for this crop is very promising where a person has the right kind of soil, and sufficient cooperation among his neighbors that all may combine to ship in car load lots. A market must be made, and when a place has become known as a shipping point, buyers will visit that point.

CUCUMBER DISEASES

For *Diseases of Cucumber* other than those listed here, see *Cantaloup, Squash and related plants.*

Anthracnose

Colletotrichum sp.

Anthracnose occurs on the leaves and stems of cucumbers and muskmelons, and on the leaves, stems, and fruits of watermelons. It also attacks other cucurbits. It is common and sometimes injurious.

Appearance

Circular dead spots from one-fourth to one-half inch in diameter are formed on the leaves. On the stems anthracnose causes elongated, discolored, and shrunken areas, which finally lead to the death of the branch. Watermelon fruits are often badly spotted by this disease, and much injury is done to the vines.

Cause

Anthracnose is due to a fungus which is related to the fungi causing anthracnose in grapes, raspberries, cotton, and beans, and the bitter rot of the apple. It is spread freely by the fruiting bodies, which are produced in abundance in the spots on the leaves and fruit. The destruction of such vines, together with rotation of crops, is recommended as a means of prevention.

BLIGHT. See *Downy Mildew*, this section.

Cucumber Rot

Cucumbers in Florida have been troubled with a disease which attacks both leaves and fruit. The plants may be attacked when very young. There appear on the leaves irregular water-soaked spots. The leaf becomes dwarfed and misshapen if the disease strikes it when young. If the sun is hot during the day the spots dry up, leaving a brown area, which will fall out. Quite often the infection starts along the edges of the leaves. The veins become affected, and it appears as if the disease follows the veins. Early in the morning, if one should examine the under side of the leaves, he would find underneath each spot a drop of bacterial ooze. Later in the day this dries, giving the appearance of a white precipitate. The spot on the cucumber fruit is small, about two millimeters in diameter. At first it is a transparent area, then in the center there appears a small white spot which is the dried bacterial ooze on the surface. If one should cut through an early spot, he would find only a water-soaked area. Later this area turns brown. This brown area spreads along the vascular bundles in the cucumber fruit. Three days later the whole cucumber is soft.

The disease is spread over the entire cucumber-growing district of Florida. Much loss is sustained while the cucumber is on its way to market The reports show that while the cucumbers are on the way to market, which takes four to five days, they become soft.

Remove affected plants from the field and spray with Bordeaux mixture, thoroughly, beginning when the plants have but three or four leaves.

O. F. BURGER,
Florida Experiment Station.

CUCUMBER SCAB. See *Spot*, this section.

Damping Off

This is a frequent trouble upon greenhouse cucumbers. It is serious often where plantings are made following lettuce attacked by rosette. The fungus in that case is the same as lettuce-rosette (*Rhizoctonia*) or lettuce drop (*Botrytis*). There is a strictly damping-off fungus (*Pythium De Baryanum* Hesse) that is sometimes troublesome. The Botrytis named at times attacks pruned parts of cucumber plants, also extending its attacks to the blossom end of young fruits. The results of Rhizoctonia on greenhouse cucumbers have been curious owing to attacks on the smaller root branches or rootlets. The growth of the vines is at times checked, accompanied by coloring of the leaves and reduced fruitfulness. Some growers have given the name "leaf-curl" to this phenomenon but it is strictly the effect of the fungus named. It has been found necessary in soil treatments where cucumbers follow affected lettuce to increase the strength of formalin drench to 4 or 5 pounds per 50 gallons of water.

A. D. SELBY,
Wooster, Ohio.

Downy Mildew

Pseudoperonospora cubensis
(B. & C.) Rost.

Downy mildew, the most destructive of all cucurbit diseases, is especially injurious to cucumbers, but also attacks melons, squashes, pumpkins, gourds, and other related vines.

Appearance

The first indication of downy mildew in the field is a yellowing of the older leaves in the center of the plant. Faintly defined angular spots bordered by the veins will then be detected. These become more distinct, and if the weather is moist an obscure violet coating of the spores may be noticed on the under side of the spots. The disease progresses from the center of the hill outward, the young leaves at the tips of the branches living longest. It spreads slowly in bright weather, but under the more favorable conditions afforded by cloudy, humid weather it often develops with the greatest rapidity, so that the fields quickly become as if scorched by fire.

Downy mildew has been known in this country since 1889, and in various years has caused serious loss, especially to the pickle industry on Long Island and in Ohio and other states. It is also destructive to cucumbers in greenhouses.

Cause

Downy mildew is caused by a parasitic fungus closely related to the destructive downy mildews of grape, onion, etc., and to the late blight of potato. So far as known, it is spread entirely by its conidia, or summer spores, produced on the lower surface of diseased leaves. These are blown about by the wind, but are very thin-walled, delicate bodies, which perish quickly when dried.

Conditions Favoring Development

The disease lives through the winter in Florida and probably spreads northward each summer. There is also good evidence that it lives over in greenhouses, which may later become the centers of local epidemics.

Spray frequently with half strength Bordeaux mixture, coating both sides of the leaves.

References

Farmers' Bulletin 231.
Connecticut Station Bulletin 56.
Ohio Station Bulletin 214.

EELWORM. See *Nematode*, this section.
LEAF BLIGHT. See *Cantaloup Diseases*.

Leaf Mould

Not important. Yields to same treatment as downy mildew.

Leaf Spot Diseases

Aside from anthracnose, downy mildew, and leaf blight there are a number of other leaf spot diseases hardly distinguishable from the above, all of which yield to the Bordeaux treatment.

Mosaic Disease

This disease of greenhouse cucumbers is analogous in character to the mosaic diseases of tobacco and tomatoes and to the yellows of the peach. It is due to an oxidizing ferment in the leaves and is transmitted like the tobacco mosaic disease, by touching first diseased and then healthy plants. The fruitfulness of these variegated yellow plants is very low and it is best at all times upon the appearance of the disease to remove the diseased plants and destroy them.

A. D. SELBY

Nematodes or Eelworms

Heterodera radicicola (Greef.) Mull.

These minute parasitic worms are often very destructive upon cucumbers under glass. The greatest injury may occur on the seedling plants, but plants of all ages are destroyed by the parasitic worms. Their presence may be known by the small, bead-like enlargements produced upon the roots or rootlets. No remedy has been discovered that is effective with plants once attacked by eelworms. The time to prevent this trouble is in the selection or preparation or treatment of the soil for greenhouse benches. Indeed the nematodes seem to be present in old sod, and to some extent in decaying vegetable matter generally. An effective remedy against eelworms consists in steaming and so treating the soil that the parasites will be destroyed. For this procedure see Ohio Bulletin 73. Also

Massachusetts Experiment Station Bulletin 55. In thus handling the soil due time must be given for draining and drying.

A. D. SELBY

Powdery Mildew

Erysiphe cichoracearum DC.

Frequent in hothouses, but not troublesome elsewhere. Selby recommends a dilute copper sulphate solution.

Reference

Ohio Experiment Station Bulletin 214.

ROOT ROT. See *Damping Off*, this section.

Spot of Cucumber Fruit or Cucumber Scab

Cladosporium cucumerium Ell & Arth.

Yields to same treatment as downy mildew.

Wilt, Bacterial Wilt

Bacillus tracheiphillus

Scattered plants wilt gradually without evidence of injury. The sap tubes are filled with a milky, stringy mass of bacteria instead of watery sap. Insects are instrumental in spreading the disease.

Spray with Bordeaux as an insect repellent. Cut out and destroy all affected plants. Practice rotation.

References

Pennsylvania Experiment Station Bulletin 110.

Farmers' Bulletin 231.

South Carolina Experiment Station Bulletin 141.

CUCUMBER PESTS

For cucumber pests other than those listed here, see *Cantaloup*, *Squash*, and related plants.

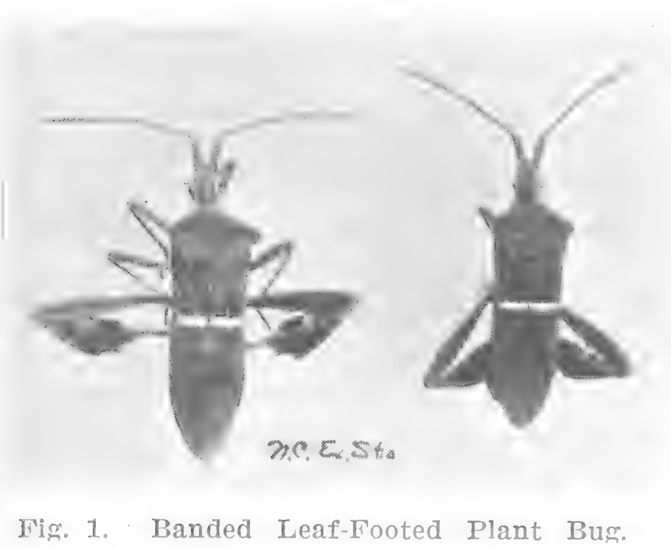

Fig. 1. Banded Leaf-Footed Plant Bug.

Banded Leaf-Footed Plant Bug

Leptoglossus phyllopus, Say

This conspicuous plant bug is a sucking insect belonging to the same family as the squash bug, and is capable of inflicting similar injury to cucurbits.

This species is distributed over all the Gulf states and many of the neighboring states. In North Carolina it is quite abundant in some sections.

Remedies

In case these bugs should become abundant, they might be controlled by hand picking during the early morning hours or about sundown, for at such times they are less active than during the heat of the day. It has been suggested that the young nymphs may be killed with kerosene emulsion.

The yellow thistle (*Carduus spinossissimus*) is their normal food plant, which suggests the advisability of keeping these plants cut down around gardens or fields where cucurbits are grown, or leaving only a few plants to serve as traps on which the bugs may be killed by spraying or hand picking.

Cucumber Flea Beetle

Epitrix cucumeris, Harr.

A small, black, oval-shaped, jumping beetle, about one-twelfth inch in length, sometimes causes quite severe injury by eating holes in the foliage of young cucumbers and other cucurbits. The larva of this species is a leaf miner, attacking the same plants, but seldom causing much damage.

Remedies

Wire screens or other mechanical covers, poison and repellent sprays, dry poison applications, clean culture are equally effective against flea beetles.

Cutworms

Various Species

These may be destroyed by the use of poison bait made by mixing bran (40 parts) with Paris green (one part) moistened to make a soft mash and then sweetened with molasses.

Distribute around the hills about sundown.

Keep the chickens out when this method is employed.

HOP FLEA BEETLE. See under *Potato Pests.*

MELON APHIS. See *Aphids.*

Melon Worm

Diaphania hyalinata Linn

This pest occurs in large numbers in Florida, Georgia and North Carolina.

Description and Habits

Parent Moths

Melon worm moths are beautiful creatures, which may often be seen flying about cucurbit fields during the late fall months. They have wings of a pearly white color, bordered with brownish black (Fig. 1). The abdomen is also pearly white, tinged with brown at the caudal end, which terminates in a large movable brush of elongated yellow and dark-brown scales. Nearly all the underside of the body, including the legs, is of the same color as the wings. The wings expand one inch, or a little more. The moths, although shy and rapid fliers, are frequently seen during the daytime.

Eggs

These are pearly white in color, very small in size, and are laid in groups of from two to six or more on the stems, leaves and buds. They hatch in about four days in warm weather.

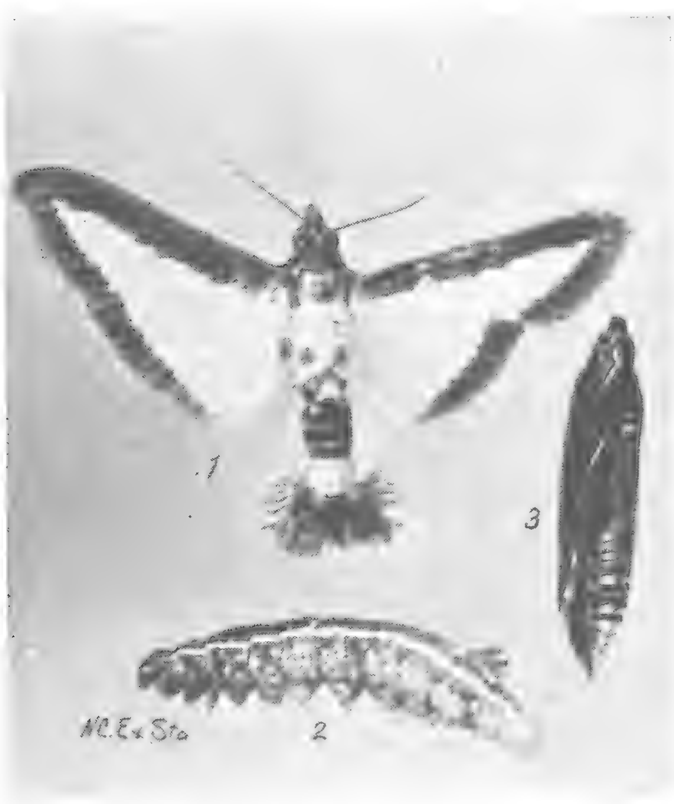

Fig. 1. Melon Worm. 1, adult; 2, larva; 3, pupa.

Larvae

Just hatched larvae are about a twenty-fifth of an inch long, with a pale brown head, and body of a pale yellow color, with no distinct markings. At about three days of age the skin is molted for the first time, and then the body shows two faint longitudinal sub-dorsal white stripes, which become more prominent as the larvae develop. By these two white stripes melon worms (Fig. 1) may be readily distinguished until they are nearly grown, when the white stripes disappear.

These worms often feed for their entire lifetime on the foliage, remaining on the underside partially concealed by thin silken webs. They also feed in the terminal bud clusters, and bore into melons and squash like the pickle worms. The habit of feeding on the foliage makes it profitable to use poison sprays as a remedy.

Cocoons and Pupae

Melon worms spin thin silken cocoons in the folded edge of some leaf, like the pickle worms, but differ from the latter in being inclined to select a green leaf rather than a dying one. When the food plants are nearly defoliated the worms crawl to nearby weeds or grass, and there spin cocoons and pupate.

Remedial Measures

Because of feeding freely on the foliage, melon worms may be poisoned with arsenical sprays, and the additional methods suggested for controlling pickle worms. See *Pickle Worm*, this section.

Supplementing the poisoning method, the complete removal and destruction of badly infested trap plants, bady infested fruit of all cucurbits, and remnants of infested crops, together with the practice of deep plowing and rotation, should suffice to prevent serious damage from melon worms. R. I. SMITH

N. C. Exp. Sta.

Northern Leaf-Footed Plant Bug

Leptoglossus oppositus Say.

This species has been reported as damaging melons in Maryland and the District of Columbia, and occurs in many

Fig. 1. Northern Leaf-Footed Plant Bug.

of the Southern states, including North Carolina.

Hand picking as for other plant bugs and destruction of young nymphs by kerosene emulsions are the remedies suggested.

Pickle Worm

Margaronia nitidalis Cramer

Description

The parent of the pickle worm is a night flying moth of rather distinctive appearance (Fig. 1). The general color, is yellowish brown. The front wings bear a yellowish, semi-hyaline spot near the center, and the hindwings have the inner two-thirds of the same appearance. The abdomen terminates in a large movable brush composed of numerous elongated scales. In size the moths have a wing expanse of a little over one inch, while the body averages about five-eighths of an inch from the tip of the head to the end of the brush. The shy, retiring habits of these moths prevent their being often observed, for they seldom fly in the daytime, unless disturbed, and then quickly attempt to hide. In this respect they differ from the melon worm moths, which are often seen flying about cucurbit fields during August or September.

Eggs

Freshly laid eggs are white, but soon turn yellowish, as the larvae inside develop. They may be laid singly, but more commonly in clusters of from three to eight, on bloom buds, leaf stalks, or leaves, and are usually attached to the plant hairs in such a manner that the egg mass seems to be pierced by the hair. The eggs hatch in warm weather in about four days.

Larvae

Very young larvae are uniformly yellowish white, but after a few days the body segments show transverse rows of brown spots, which become more prominent and nearly black in color before the fourth molt is passed (Fig. 1). Larvae molt four times before attaining full growth, and their distinctive marking, previous to the fourth molt, enables one to separate them readily from the related species called the melon worm. After the fourth molt pickle worms become greatly changed in appearance by practically losing the transverse blackish spots. Pickle worms feed in bud clusters, blooms or fruit and often in the vines, but seldom feed, like melon worms, on the foliage.

Fig. 1. Pickle Worm. 1, Moth magnified twice; 2, Larva before fourth moult; 3, larva ready to pupate.

Fig. 2. Pickle Worm Injury to Cantaloup.

Cocoons

The cocoon is a thin, scanty covering of white silken threads, spun by the worm in a fold of some leaf before transforming to the pupal stage. They are generally found in dead or dying leaves near the ground, or lying on the soil under the infested plants.

For this reason the practice of raking up and burning or composting remnants of infested crops, followed by deep plowing, is of value.

Remedial Measures

Early plantings of cantaloupes and cucumbers may escape injury from this pest in the South.

Trap Plants

Pickle worms evince a decided preference for the buds, blooms and fruit of summer squash.

To secure the best results, seed should be planted two or three times at intervals of about three weeks, making the first planting in time to insure having the squash plants blooming freely by the middle or latter part of June. They must then be examined frequently, and, when worms are discovered, infested blooms and fruit should be gathered and destroyed at least once a week.

Destroy infested plants and fruit and as soon as the crop is gathered rake up and destroy all vines, weeds and trash.

R. I. Smith

N. C. Exp. Sta.

Potato Flea Beetle. See under *Potato Pests*.

Striped Cucumber Beetle

Diabrotica vittata Fab.

General Appearance

The adult beetles are small, measuring about two-fifths of an inch in length and half as much in width. The color is yellow above with black head and three black longitudinal stripes on the wing covers. The under surface as well as parts of the legs and antennae are black. The larvae are very small white grubs with head, anal and thoracic plates brown. They live in the earth. The eggs are oval in shape and bright lemon to orange in color and are laid in the soil.

Fig. 1. Striped Cucumber Beetle.

Life History

The adult beetles hibernate over winter under rubbish or in other protected places, and emerge during the early spring months of April and May. As soon as the host plants appear the eggs are deposited in the soil around the bases and hatch in about nine days. The larvae upon hatching feed at the base of the plants upon the roots and stems. The greatest damage is done by the adults boring down into the soil and feeding upon the tender appearing foliage. Throughout the entire summer they continue as foliage destroyers and do much damage. They also act as carriers of the bacterial wilt disease of cucumbers.

Food Plants

Squashes, cucumbers, cantaloupes, pumpkins and watermelons are its favorite food plants and suffer most from its

attacks. Peas, blossoms and leaves of the apple and numerous other cultivated and wild plants are devoured.

Control

In many instances control measures are necessary. Cheap coverings are especially desirable for small plantings and may be very practicable for extensive fields. When no coverings are used the plants may be started early in hothouses and set out after they are well established. If the plantings are made directly in the field an excess of seed should be used to allow for the destructiveness of the beetles.

Poison sprays, such as arsenate of lead or Paris green, aid much in controlling it, but successive applications are necessary, because of the rapid growth of the plants. The poisons are sometimes added to Bordeaux mixture and serve as a remedy for fungous diseases as well. In small patches pyrethrum is an excellent remedy.

Repellents such as land plaster or gypsum soaked in turpentine or kerosene or tobacco dust placed around the hills will tend to drive the beetles away. Bordeaux mixture is also considered a good repellent.

E. O. Essig

Common or Greenhouse White Fly

Aleyrodes vaporariorum Westw.

General Appearance

The adult white flies are about three-fiftieths of an inch long, the males being slightly smaller than the females. The bodies are yellow and the wings pure white. The eggs are exceedingly small, oblong in shape, at first light green, growing black with age and attached by a short stipe. The larvae are light in color, transforming to flat pupae about three-hundredths of an inch long; oblong-oval in shape; light green and supporting noticeable wax-like rods or spines, which makes this species readily distinguishable from all others.

Life History

The eggs are laid upon the leaves of the plants, each female depositing over 100. These hatch in about two weeks into larvae which begin feeding very shortly and after three moults, covering nearly a week, they become pupae, which after two more weeks are ready to emerge as adults. These feed during their life of thirty days.

Tomatoes and cucumbers suffer most.

Fumigation as for scale insects is the best method of control, but emulsions and resin sprays are effective.

E. O. Essig

Western Twelve-Spotted Cucumber Beetle

Diabrotica soror Lec.

General Appearance

A small green black spotted beetle about the size of, and often mistaken by farmers for, a ladybird beetle. The ventral surface is entirely black. The larvae are white and subterranean in habits, so are seldom met with.

Life History

The eggs are laid in early spring around the bases of the food plants from one-half to one-fourth of an inch under the ground. They hatch quickly and the white grubs begin feeding upon the roots. The pupal cells are made near the surface and in about two weeks the adult beetles emerge. The broods overlap throughout the summer, there being two distinct generations. The adults hibernate during the winter.

Food Plants

Beets, melons, cucumbers, squashes, beans, corn, cabbages, peas, zinnias, daisies, orange, alfalfa, peanuts, potatoes, spinach, lettuce, mustard, roses and chrysanthemums.

Control

It is seldom necessary to resort to control measures for the larval forms, though they often do much damage. For the adults, however, control measures are often urgent. Poison sprays applied to the tender growth are very effective.

Natural Enemies

Two natural enemies prey upon this beetle; one a tachinid fly, *Celatoria diabroticae* Shim., and the other a spider, *Xysticus gulosus* Keys.

E. O. Essig

Currant

The currant derived its name from the Greek city of Corinth, where it was first cultivated and became commercially important. Many new varieties have been developed, chief of which is the red currant, *Ribes rubrum,* from which have grown several white varieties and many red varieties as well. One peculiarity of the currant is its tendency to variation in color. It is not very unusual to find red, white and striped berries on the same stalk.

There is a black species, *Ribes nigrum,* which is popular in some parts of Europe, but not so in America, because of its peculiar flavor, because it is a light bearer and is not commercially profitable. The principal use to which this fruit is applied is in the making of jellies; although it is used fresh for the table, and in the making of pies.

There is also an American black currant, *Ribes floridum,* or *Americanum,* which resembles the black currant of Europe, but is not much esteemed. There is an American species of flowering currant, *Ribes aureum,* but it is not cultivated for its fruit, since it ripens very unevenly and is not of first-class quality.

On the Pacific coast several varieties classed as *Ribes sanguineum,* are grown for ornament, mostly producing a red flower.

The currant is native to the United States, and many parts of Europe. It thrives best in cool, rather humid climates; upon soil that is rich, well drained, and with a clay subsoil. However, it may be grown in hot climates, if planted on the north side of buildings, or where the plants are shaded by trees of larger growth; provided that the ground is sufficiently fertilized to support the larger trees and currants as well.

The plant is propagated mainly by means of cuttings which may be planted either in the autumn or spring; but if planted in the spring the planting should be early, as they begin to grow earlier than most other shrubs or trees. The cuttings should be made from six to eight inches long, cutting just below the bud for the root, and just above the bud for the top. There is no secret about planting, except that there should be a careful preparation of soil, and the cuttings should be set so that at least two buds shall be below the surface of the soil, and one or two buds above the surface. The planting may be done with a spade, or a furrow may be plowed and the plants dropped against the perpendicular side of the furrow, and the dirt pressed firmly against them. Currants may be propagated by means of roots; but it is generally done by means of cuttings. Seeds are planted, if it is desired to originate new varieties.

There is considerable difference of opinion about the distance of planting; some say the rows should be made four feet apart, and the plants three feet apart in the row. Others say the rows should be eight feet apart and the plants five feet apart in the row. If I were planting and the ground was so that one could use the square method, I would plant them according to that method, five feet apart each way, then cultivate both ways. By this means, I think labor could be saved and better fruit produced. In adopting this method, there would be a waste of land for the first and second years of growth, but if so desired some other crop could be grown between the rows until the currants needed the soil and space.

Cultivation should be shallow, as the roots are fine and grow near the surface of the soil.

Pruning is a simple process, although it is impossible to reach good results if it is neglected. It should be remembered that the fruit is borne on both the old and the new wood, most of it near the base of the one-year-old shoots. Consequently most of the wood more than one year old might be cut out and still a crop be produced, or most of the new wood might be pruned off and a crop result; but the new wood bears the stronger, better fruit, so it is better to sacrifice the old stalks. Card says: "For field culture, four to eight main stems are allowed, and these should be frequently renewed." It is my judgment that wood

Plate I. Currants. 1. Pomona—Bright red, sweet, very prolific; hangs on a long time; excellent, early. 2. Red Cross—Bright red, large, prolific; mild flavor; excellent, early. 3. Victoria—Bright red, hardy, prolific, a popular variety; blooms late and avoids spring frosts; excellent, late. 4. London Market—Red, firm, acid, prolific, excellent, early. 5. La Versaillaise—Medium sized, dark red, not prolific here. 6. Wilder—Light red, mild, hangs on a long time, excellent, early. 7. Cherry—Dark red, large, not very prolific, good, mid-season. 8. Fay's Prolific—Red, large, prolific, excellent, mid-season.

Photo and Descriptions by J. H. Stahl, Western Washington Experiment Station.

more than three years old should be cut out.

Like most other fruits, currants should not be picked when wet; as they tend to mold or decay if so treated.

GRANVILLE LOWTHER

Currants for the Home Garden or Commercial Plantation

The currant is one of the few fruits that if planted at all in the home garden is permitted to grow at will, usually more or less choked with grass and weeds or rarely or never given any pruning or cultivation. While it will exist under such conditions, it rarely gives satisfactory returns and for this reason is not generally considered a profitable commercial crop in many parts of Washington.

Propagation

The currant, like all other cultivated fruits, does not "come true" from seed, so, for this reason, it is necessary to propagate it by means of cuttings, layers or division.

The wood for cuttings should be of the current year's growth and may be taken any time between the falling of the leaves in the summer and the beginning of growth in the spring. The strongest plants and most satisfactory results are usually secured from cuttings made early in the fall and planted immediately. The cuttings are usually made from seven to eight inches long. The lower end should be cut just below a bud while the upper end may be from one to two inches from a bud, depending upon the length of the wood. If the cuttings are made late in the fall or during the winter it is usually best to pit them in a callousing pit or pack them in damp moss or soil in a cool cellar until early spring. They should then be planted in deep, rich, moist soil in nursery rows three or four feet apart and the cuttings six or eight inches apart in the row. Plant down to the top bud, making the soil very firm around the base of the cuttings in order to prevent drying out during the summer months. After from one to two year's growth the plants will be in excellent shape to set in the permanent plantation.

Soil

Almost any good rich soil of sufficient depth and fertility to produce a good crop of grain will produce good crops of currants. While this class of fruit may be grown in hot, dry soil, the best results are secured on cool, moist soils. A well drained, rich, sandy loam with considerable humus in it, or even clay loam properly treated, will give excellent results if there is plenty of available plant food. When the soil becomes very hot and dry during the summer it is sometimes advisable to mulch with coarse litter in order to hold the moisture and keep the temperature down. It is difficult, however, to grow good, clean fruit under these conditions. As a plant the currant is a heavy surface feeder and so should receive heavy annual dressings of well rotted manure or a substitute for manure in the form of commercial fertilizers.

Planting

One or two-year old plants from cuttings or layers give better results for the permanent plantation. Most planters prefer a one-year-old plant, as it is easier to handle than the two-year-old plants.

Early fall planting gives good results where the plants are mulched before the cold weather comes on, but for general planting early spring gives the best results, especially where the stock is secured in the fall or winter and is set out just as soon as the ground is ready to receive the plants in the spring. Late spring planting is not satisfactory since the rootlets and shoots of the currant begin to form early and are easily damaged in handling.

The same care should be exercised as in planting a fruit tree. All broken or bruised roots should be removed, the top thinned and cut back and the plant set from one to two inches lower than it stood originally in the nursery.

The square planting plan of 6x6 feet is commonly used. However, it does not give sufficient room for the bushy sorts, especially after they begin to bear and the limbs become weighed down with the heavy crops of fruit. A better plan

would be to place the rows eight feet apart and the plants six or seven feet in the row. This would allow room for thorough cultivation.

Cultivation

If the plantation has received an application of well rotted manure during the winter this should be worked into the soil as early as the ground is ready to work in the spring. This may be done by shallow plowing or deep, double shovel work. After thoroughly working the manure into the soil the surface should be left smooth and as near level as possible. Regular surface cultivation should continue until picking time. After the crop is harvested, the plantation should again be thoroughly cultivated and then the plants permitted to become dormant and ready for winter. Late summer or fall growths should always be discouraged as there is danger of fall or winter injury resulting from the unripened condition of the shoots.

Pruning

The currant will bear some fruit every year whether it is pruned or not, but, if fine, large fruit is desired pruning is necessary. There are two general types of training currant plants, i. e., the tree form and the bush form. The tree form is developed by cutting away all the shoots but one and the removal of the lower buds and branches from this shoot for from twelve to twenty-four inches from the ground, which results in a little tree. This method does very well for the amateur or the novice, but is not practical from a commercial point of view on account of the unproductiveness of the plant and the danger of a borer destroying a whole plant instead of one cane, as is frequently the case with bush grown plants. The bush form is the more common method used not only in commercial but in home gardens as well and results in the development of a well formed bush of from six to eight two to three-year-old fruiting canes, and from two to four young shoots or one-year-old fruiting canes. The common difficulty with the currant bush is that there is too much wood left annually upon the plant and so it is compelled to produce a great number of small berries instead of greater or equal weight of fine large fruit. While currant wood will produce fruit for an indefinite period of time, yet after it passes its fourth to fifth year it ceases to be valuable on account of the inferior quality of its fruit. Good, healthy wood produces its best fruit during the second and third years of its life and should be replaced by young shoots before it reaches its fifth year.

In ordinary field culture, from five to eight bearing canes on a plant will give better results than a greater number, especially where these canes have been summer pinched in order to develop strong lateral buds. If these shoots have produced strong, lateral shoots they should be cut back to from three to four inches in length. For market purposes it is better to remove too much wood and produce a small quantity of fine fruit than not enough and produce an unsalable crop of small fruit. Pruning may be done in the fall or early in the spring. Ordinarily it is best to do it just before the plants start into growth in spring.

Harvesting and Marketing

Since the currant is largely used for jellies and spice purposes, a rather tart fruit is more desirable than a thoroughly ripened fruit. For this reason as well as the better shipping qualities of slightly green fruit, currants should be picked just before they are ripe rather than after they have become fully ripe. Fruit picked while it is cool ships much better than fruit picked during the heat of the day. Under no consideration must fruit be picked while it is wet with rain or dew, as it soon spoils if handled while wet. The bunch should be removed whole from the plant and kept whole, never shelling or stripping the bunches, as it is sure to lower the grade, if not ruin the fruit entirely.

Up to the present time there is no established method in the West, for marketing currants. The common 24-quart crate is extensively used and is undoubtedly the best and most adaptive Western package. A few growers use a

ten or twenty pound shallow box for near markets, but find it unsatisfactory for long shipments. The pony refrigerator can be advantageously used for the fancy grades, but should not be used for anything but the best.

Discussion of Varieties

The size, color, productiveness and attractiveness of the Red Cross currant makes it an especially valuable new sort, while the mild flavor, productiveness and good plants of the Wilder places it at once among our best sorts. The older standard sorts, like the Victoria, Pomona and Cherry, are popular and very valuable for home as well as commercial purposes.

The following notes on varieties were secured from the plants in the experiment station grounds at Pullman, Wash.:

Red Varieties

Cherry

A weak, spreading bush with long canes which frequently break in the wind. The foliage is dark green, abundant and practically free from disease. The berries vary in size from medium to very large, but are usually very large, of a dark red color and are borne in loose, short, poorly-filled clusters. An early to medium productive sort, valuable for home use, but not good for commercial purposes on account of its short-stemmed clusters, which makes picking rather expensive.

Comet

A medium to large, irregular shaped plant with good strong canes and an abundance of dark green, healthy foliage. The berries are rather large, dark red, of a brisk acid flavor and borne in long-stemmed, loose, but well filled clusters. A new, very productive, mid-season sort, not commercially grown.

Fays Prolific

A large, spreading, irregular shaped bush, with good, strong, erect canes and an abundance of large, light green, healthy leaves. The berries are large, of a dark red color, medium acid flavor, and borne on fine, long branches. A very productive, late season sort. Valuable for commercial as well as home use.

La Versaillaise

A large, spreading, irregular shaped bush with good, strong canes and an abundance of large, dark green leaves. The berries are medium sized, of a dark red color, with a brisk acid flavor and borne in long, loose, poorly filled clusters. A good market sort, commonly grown, but not very productive in many parts of the state.

London Market

A large, strong growing, erect bush with slender, erect canes, which stand the wind well, but break very easily when handled during picking. The foliage is dark green, abundant and free from diseases. The berries are medium to large, of a bright red color, mild subacid flavor and very attractive. The bunches are of medium size, short, compact and well filled, making a very showy market sort. A very fine mid-season, productive variety.

Long Bunch Holland

A rank growing, stocky plant, with short, heavy erect canes and an abundance of dark green healthy leaves. The berries are small, of a bright red color, rich acid flavor and are borne in long, loose bunches. A popular mid-season sort, but not so profitable as many larger fruited sorts.

Perfection

A large, strong, upright growing plant, with long, erect, strong canes and an abundance of fine, dark green foliage. The berries are very large, of a bright red color, brisk acid flavor and are borne in short, compact, well filled clusters. A new, very productive, mid-season variety. Valuable for home as well as market purposes.

Pomona

A large, rank growing bush with erect, rather slender canes and an abundance of small dark green leaves. The berries are medium to large, of a dark red color, a mild acid flavor, and are borne in long, well filled clusters. A comparatively new variety for home as well as for market purposes.

Red Cross

A strong, erect growing plant with stiff, short canes and an abundance of dark healthy leaves. The berries are very large sized, of a dark red color; a mild acid flavor and are borne in long, loose well filled bunches. A comparatively new variety that is rapidly becoming popular for market and home use on account of its large size and productive habits.

Red Dutch

A large, irregular shaped bush with slender, long canes and an abundance of fine, dark green foliage. The new canes frequently suffer severe injury from the summer winds. The berries are small, dark red, mild acid and are borne in short, poorly filled clusters. An old, very productive, and, while small fruited, popular sort.

Victoria

A strong growing, upright, productive bush, with heavy upright canes and an abundance of dark green healthy foliage. The berries are very large, bright red, of a mild acid flavor and borne in rather

Plate II. Currants. 9. Fertile de Palluau—Large, red, not prolific here. 10. White Grape—White, mild, prolific, excellent, mid-season. 11. Red Dutch—Bright red, acid, small, good. 12. White Transparent—Very similar to White Grape, mid-season. 13. Black Naples—Large, black, not very prolific, good, late.

Photo and Descriptions by J. H. Stahl, Western Washington Experiment Station.

small, poorly filled loose bunches. One of our best late sorts.

Wilder

An irregular shaped, spreading, very productive bush with strong, spreading canes and an abundance of fine dark green foliage. The berries are of medium size, dark red color, very mild subacid flavor and are borne in loose, short stemmed bunches. Its mild flavor and fine quality with other admirable traits make this an excellent sort where a table fruit is desirable.

White Varieties

White Grape

A medium sized, flat spreading, very productive bush, with long, slender canes and an abundance of healthy, dark green foliage. The berries vary greatly in size, but average well, are of a light greenish white color and excellent quality. The bunches are long, loose and poorly filled. A very valuable sort for home table use, but not popular as a market sort. The yellow and white fruited forms of practically all kinds of small fruit are not so popular in the market as the bright colored sorts.

European Black Varieties

Black Champion

A large, rank growing, spreading bush with slender, recumbent canes and an abundance of dark green foliage. The berries are medium sized, black, of good quality, and are borne in short, poorly filled bunches. While a very rank grower, this variety is a very shy bearer.

Black Victoria

A very large, strong growing plant, with strong, erect canes and plenty of dark green foliage. The berries are of medium size, pure black color and pleasant flavor. The bunches are medium sized but poorly filled. This is the best and most productive black sort tested. None of the black varieties are of commercial importance in the West but are occasionally grown for home use.

American Black Variety

Crandall

A large, rank growing, spreading plant with long, strong, erect canes and a rather small amount of light green foliage, which is frequently diseased. The berries are variable in size, of a blue black color and rather sweet flavored. The bunches are small, poorly filled and the plants are not very productive.

None of the Missouri Yellow Flowering currants are profitable for fruit production; nor should they be grown near the red or white sorts as they are nearly always the harboring places for the currant fruit worm, which is so hard to combat and does so much damage in many parts of the state.

W. S. Thornber,

Washington Experiment Station Popular Bulletin 26.

Currants for Alaska. See *Alaska.*

Varieties To Be Planted

The following varieties are recommended by the American Pomological Society for planting in the various districts: (See Map, p. 192.)

District No. 1

Recommended as successful — Champion, Lee's Prolific, Naples, Saunders, Albert, Red Cross, Red Dutch, Red Grape, Versaillaise, Victoria, White Dutch.

Very successful—Cherry, Fay, White Grape, Wilder.

Recommended for trial—Moore's Ruby.

District No. 2

Successful—Champion, Lee's English, Naples, Saunders, Albert, Holland, London, North Star, Pomona, Red Dutch, Versaillaise, Victoria, White Dutch, White Gondouin.

Very successful—Cherry, Fay, Red Cross, Wilder.

Recommended for trial — Wales, Moore's Ruby, Perfection, Raby Castle, St. Giles.

District No. 3

Successful—Lee, Moore's Ruby, Red Dutch, Versaillaise, Victoria, White Dutch, White Gondouin, White Grape.

Very successful—Cherry, Fay, Wilder.

Recommended for trial—Naples.

District No. 4

Recommended as successful—Black Champion, Lee, Wales, Victoria, White Dutch, Wilder.

VERY SUCCESSFUL—Cherry, Fay, Red Dutch, White Grape.'

RECOMMENDED FOR TRIAL—Crandall, Albert.

District No. 5

RECOMMENDED AS SUCCESSFUL—Crandall.

RECOMMENDED FOR TRIAL—St. Giles.

District No. 6 and District No. 7

Includes Florida, and the Southern states bordering on the Gulf where it is too hot for currants.

District No. 8

RECOMMENDED AS SUCCESSFUL—Champion, English, Holland, Versaillaise, White Dutch, Wilder.

VERY SUCCESSFUL—Cherry, Fay, Perfection, Red Dutch, Victor, White Grape.

RECOMMENDED FOR TRIAL — Crandall, Wales.

District No. 9

RECOMMENDED AS SUCCESSFUL — Champion, English, Lee, Naples, Wales, Albert, Cherry, Fay, Perfection, Red Cross, Red Grape, St. Giles, Victoria, Wilder.

VERY SUCCESSFUL — Holland, London, North Star, Pomona, Red Dutch, White Grape.

RECOMMENDED FOR TRIAL—Saunders.

District No. 10

RECOMMENDED AS SUCCESSFUL—Cherry, Defiance, North Star, Red Cross, St. Giles, White Grape.

VERY SUCCESSFUL — Red Dutch, Red Grape.

District No. 11

This district includes a part of Texas and New Mexico, and is not adapted to currants.

District No. 12

RECOMMENDED AS SUCCESSFUL—Albert, Holland, Victoria, White Grape.

VERY SUCCESSFUL—Cherry, Fay, Red Dutch, Versaillaise, White Dutch.

RECOMMENDED FOR TRIAL—English, Lee, Red Cross, Red Grape, White Gondouin, Wilder.

District No. 13

RECOMMENDED AS SUCCESSFUL—Champion, Lee, Naples, Saunders, Wales.

District No. 14

RECOMMENDED AS SUCCESSFUL—Champion, North Star, Red Cross, Red Dutch, Red Grape.

VERY SUCCESSFUL—Cherry, Fay, White Grape.

RECOMMENDED FOR TRIAL—Perfection.

District No. 15

RECOMMENDED AS SUCCESSFUL—Cherry, Victoria.

VERY SUCCESSFUL—Fay, White Dutch, White Grapes.

District No. 16

RECOMMENDED AS SUCCESSFUL — Fay, White Dutch.

District No. 17 and District No. 18

Include part of California and Arizona, where it is too hot for currants.

CURRANT DISEASES

Anthracnose

Pseudopeziza ribis

H. S. JACKSON

Currant anthracnose seems to be the most common fungous disease of this fruit which occurs on the Pacific coast. It seems to be widely distributed in the state and is generally known throughout the United States. It is also common in Europe. This disease is known to attack the gooseberry, but usually not in a serious form. It is more severe upon the red and white currants than upon the black.

Symptoms

The disease is primarily a leaf disease, though it may grow upon practically all parts of the plant above ground including the fruit. On the leaf the disease causes small brown spots which are more or less thickly scattered. When abundant the affected leaves turn yellow and fall. This disease is probably the cause of much of the premature defoliation of currants. The general effect of the fungus is to interfere with the proper development of the fruit and generally to reduce the vitality of the plants, thus interfering with the proper ripening of the fruit and the formation of the fruit buds for the next year. Spots of the disease may also occur upon the petioles and young canes and upon the fruit stalks and young

fruits. Conspicuous black spots which are slightly sunken are formed on the leaf stalks and petioles and also on the fruit stems. Here the spots are black and from one-fourth to one-half inch long. On the fruit black spots resembling fly-specks are formed.

On the young canes the disease produces only a slight discoloration; it occurs only upon young canes of the current year's growth, and is very difficult to detect.

Where plants are in partial shade they are not as seriously attacked. Older plantations are found to be more seriously affected than more recent plantings.

Cause

This disease is caused by a fungus known technically as *Pseudopeziza ribis*. The fungus exists in two spore stages. In the spots on the leaves, petioles and canes, the summer spores are produced in peculiar fruiting structures known as acervuli; these are doubtless disseminated by wind and spattering rain, and when coming to rest upon any part of the plant grow into the tissues and cause new spots.

It has been proved that the fungus matures on the stems, and it is possible that it winters over on the canes in this condition.

It is certain that the fungus is carried over the winter by the foliage, which lies on the ground.

Treatment

The first infection results from the dissemination of spores from the dead leaves of the previous season, and any method of destroying these leaves might tend to reduce the seriousness of the attack. It would be advisable, therefore, to plow early, before the leaves come out in the spring, in order to bury the dead leaves. Where practicable, raking and burning the leaves would have the same result and would probably be more effective. A dormant spraying toward spring, to prevent any further development of the summer spores on the canes, would be advisable. Use the Bordeaux mixture 5-5-50. Spray again when the leaves unfold and repeat at intervals of ten days until the fruit is two-thirds grown, avoiding the blossoming period. If summer rains are abundant it may be found profitable to spray once or twice after the fruit is gathered.

Black Knot. See under *Cherry Diseases*.

Cane Blight

Nectria cinnabarina (Tode) Fr.

This is a very serious disease whenever stools are attacked by it. The fungus survives by its threads in the tissues of the stool and upon the death of the canes develops as a bright pink mass of the fungus upon dead parts. While spraying may, and surely must, keep down the risk of infection, whenever stools show attacks by dying of a part of the canes and the development of this fungus these infected stools are doomed and should be removed and burned. A. D. Selby

Reference

Duggar, Fungus Diseases of Plants.

Currant Blight, Currant Cane Blight, Currant Cane Necrosis

Botryosphaeria ribis

An Old, Obscure Disease

More than twenty years ago, a disease was discovered which has become today a very destructive trouble in the currant plantations of the Hudson valley, New York. The cause of this disease remained long unknown; but careful study by botanists of the Geneva and Cornell stations proved it to be due to a fungus which has three distinct spore forms Of these, the basal form is *Botryosphaeria ribis*, so that this stands as the scientific name of the fungus which causes currant blight, currant cane blight, or currant cane necrosis. Usually, the discovery of the cause of a disease soon leads to a remedy, but in this case no preventive or remedial treatment can yet be recommended.

Symptoms of the Disease

On certain canes, or portions of the canes, the leaves wilt, turn brown and die. An affected cane will show a section of dead wood from one to four inches long where the bark has been killed and wood and pith invaded by the

mycelium of the fungus. This hinders the ascent of sap and thereby causes all the upper part of the plant to wither and die. The general appearance is very similar to that caused by borers in the canes, but when this insect is responsible, a distinct burrow will be found and the larva, itself, may be present. In fungus-blighted canes, neither burrow nor larva can be found, but on careful examination, especially with a microscope, fine, whitish, cobwebby threads may be discovered in the discolored pith at the point of attack.

Dropsy

This disease causes very considerable enlargement upon the young stems of the currants, not unlike in appearance the enlargements due to crown gall in the peach, except that usually more of the stem is involved than in the other case. The trouble appears to be due to physiological causes and the pruning knife may aid cultural efforts.

European Currant Rust

Cronartium ribicola Fisch. de Waldh

An outbreak of this rust has been reported from New York, although before 1906 supposed to have been confined to Europe and Asia. It appears also upon the white pine. No practical means of control seems at hand.

References

Ohio Bul. 214.

Duggar, Fungus Diseases of Plants.

Knot

Due to a fungus, requires further investigation.

Leaf Spot

Septoria ribis, Desm.; *Cercospora angulata* Wint.

Leaf spot of currants is referable to two species of fungi. These fungi produce early spotting and premature dropping of the currant foliage; in some instances the leaves drop even before the fruit has ripened. Bordeaux mixture applied as per calendar is effective against this disease, though late applications may render it necessary to wash the fruit. For this reason, if for no other, the first application should be made very early and followed by about two more at fortnightly intervals.

A. D. S.

Powdery Mildew. See under *Gooseberry Diseases*.

Wilt. See *Currant Blight* this section.

CURRANT PESTS

American Currant Borer

Psenocerus supernotatus Say

When red and white currants are leafing out in spring, some bushes are noticeably slower in expanding their foliage than other individuals of the same variety. This is frequently due to the presence of stem-boring larvæ, either those of the above beetle, which are white, cylindrical, and without feet, about a quarter of an inch in length, or those of the imported currant borer, which somewhat resemble the above but have a brown head and short legs beneath the body. The parent of the American currant borer is a small, narrow, brownish-black beetle, about ¼-inch long, with long slender feelers and two conspicuous white spots on the back towards the end of the body, and two smaller dots about the middle. These beetles may sometimes be found in the month of June crawling about upon the bushes. The eggs are laid in summer, and the young grubs burrow inside the canes and do not change to pupæ until the following May. The attack of this insect, although occasionally serious to fruit growers, is only an exceptional one, for the species propagates much more freely in the stems of the Virginian creeper.

Remedy

When currant bushes are being pruned, all the wood which is cut out should be burnt and if the presence of this insect or of the currant borer is detected by the black burrows in the centers of the stems, such stems should be pruned down until the larva is found, so that it may be destroyed.

Cottony Scale. See *Apple Pests*.

Currant Aphis

Myzus ribis L.

When the leaves of currant bushes are nearly full grown, many of them bear

blister-like elevations of a reddish color, beneath which will be found yellowish plant-lice, some winged and some wingless. The blisters are due to the attacks of these insects, and when, as is sometimes the case, they are very abundant, considerable injury is done to the bushes.

See *Aphids.*

Remedy

Spraying forcibly with whale-oil soap solution or kerosene emulsion will destroy large numbers of these plant-lice at each application; but the liquid must be copiously applied and driven well up beneath the foliage by means of an angled nozzle. Two or three applications at short intervals may be necessary.

Currant Leaf Hopper

Empoasca mali, Le Baron

A frequent cause of considerable injury to the leaves of currants and gooseberries, is a small pale green leaf hopper which during May and June is found in large numbers beneath the leaves, from which it sucks the sap. This is the same insect that is often so abundant upon apple trees. The mature insect is a slender leaf hopper less than 1/8 of an inch in length, and passes the winter beneath rubbish, leaves, etc. It flies to the bushes in spring, as soon as they leaf out. The young wingless leaf hoppers of the first brood may be found about the beginning of June, and should be destroyed before they develop their wings and propagate.

Remedy

Spraying the bushes with kerosene emulsion or whale-oil soap solution before the insects become winged, is the best remedy. Care must be taken to drive the liquid well up under the leaves.

See also *Apple Pests.*

James Fletcher,
Ottawa, Can

Currant Maggot or Gooseberry Fruit Fly

Epochra canadensis Loew

A. L. Lovett

This insect is possibly as serious a pest of the currant and gooseberry fruits as we have in the Northwest. The attack is on the fruit itself and causes it to become prematurely ripened and altogether worthless. The first indication of injury due to this insect is a small spot on the one side of the fruit where growth has apparently ceased. Later the fruit shows a cloudy appearance, becomes prematurely ripe and upon examination reveals a dark spot in the interior, which proves, when the fruit is opened, to be a small footless grub. The fruit drops to the ground, and as a result, the crop is shortened greatly or is entirely ruined.

The adult of this maggot is a very pretty two-winged fly about the size of a house fly. It is of a pale yellow or orange color. The wings are marked with dusky bands. The grub or maggot is footless, white in color and with the body composed of 13 segments. The head is armed with a pair of black, parallel, retractile hooks, the rasping organs of the maggot.

Life History

The adult flies emerge during May and may be observed about the bushes during late May and June. Soon after emergence the female commences depositing eggs. One female may lay as many as 200 eggs; usually she will deposit but a single egg in a fruit. The egg-laying process is interesting; the fly alights on the fruit and hurries about in a nervous manner, keeping the wings in constant fanning motion. When at last suited with the location she pierces the fruit with her ovipositor and pushes the egg under the edge of the skin. The egg hatches into a small white grub, which at once commences to feed and travel. Its route may be readily traced just under the skin by the discolored path of injured cells and excrement left behind. After traversing a greater or less distance around the fruit, the maggot turns to the interior and enters one of the seeds. After growing too large to remain in a seed, it binds several seeds together and continues to feed on their contents. Occasionally the larvæ leave the fruit before it drops to the ground. More often they remain in the fruit until after it has fallen, where they complete their growth, and when ready to transform to a pupa crawl out of the fruit and into the soil. They enter the soil to a depth of about one and one-half inches, where they form

an earthen cell and transform to a pupa. They remain in the soil as a pupa until the following May when they emerge as adult flies.

Control Measures

This insect is not an easy one to control The fact that the egg is deposited under the skin of the fruit and that the larva spends its entire existence in the interior, makes poison sprays for the larva of no avail.

Sweeping

An insect net swept over the vines in the early forenoon during June should collect many of the flies. They could then be dipped in hot water or suds.

Poultry

Young poultry allowed to run in the patch a few hours each day will pick up the fallen fruit containing the maggots and materially lessen next season's crop of flies.

Spading

Advantage may be taken of the fact that the pest spends nearly 11 months in the soil. Spade up the soil thoroughly to a depth of four or five inches close up about the bushes. This will break up the pupal cells and expose the insect to unfavorable weather conditions and the attack of its enemies.

Mulching

Mulching heavily with straw in the spring might prevent the flies from emerging as they are very weak when newly emerged.

Currant Soft Scale

Lecanium ribis Fitch

There are occasionally noticed upon the stems of currants and gooseberries clusters of large swollen dark-brown polished scales, about 1-10 of an inch in diameter, beneath which, when mature in July, large numbers of white eggs may be found. These hatch during that month, and the small, mite-like young crawl all over the plant and suck the sap from the leaves and young growth. By autumn they have grown but little and are covered with a flat brown scale about 1-32 of an inch in length. As winter approaches, they crawl on to the twigs and pass the winter there. During the spring of the next year they grow rapidly and, as they are sometimes in such numbers as almost to cover the twigs, they do a considerable amount of harm by sucking the sap at the time when the bushes require all their vigor to ripen fruit.

Remedy

Spraying the bushes in winter time either with the lime-sulphur wash or with kerosene emulsion, is the best treatment for this scale.

Currant Span Worm

Cymatophora ribearia Fitch

This voracious caterpillar, which frequently does much harm to currants and gooseberry bushes, but particularly to the black currant, is more difficult to control than the common currant worm, the larva of the imported currant sawfly. The caterpillars are about an inch in length, of a whitish color, with yellow stripes down each side, and one down the middle of the back; the whole body is dotted with black spots of different sizes. There is only one brood of this insect in the year, the moths appearing about the end of June and in the beginning of July. The eggs are laid on the twigs during the latter month, and remain there unhatched until the following spring. The caterpillars may be found during June.

Remedy

It is necessary to use a much stronger poison for the currant span worm than for the ordinary currant worm. Paris green, arsenate of lead, or some other arsenical poison, are preferable to the white hellebore usually recommended. When occurring only in small numbers, handpicking is practicable, owing to the habit of the caterpillar of letting itself down by a strong silken thread when the bushes are disturbed.

In addition to the above, which is the commonest of the span worms found on gooseberries and currants, there are occasionally found two much larger caterpillars of the same shape and looping movement of the body when walking. These are those of the currant angerona (*Xanthotype crocataria*, Fab.) which has a caterpillar an inch and a half long or

more when full grown, of a yellowish-green color, with a whitish line down the back and a broad white band on each side bordered with pale purple, below the spiracles, and the pepper and salt currant moth (*Lycia cognataria*, Gn.), which has a large caterpillar two inches long, varying in color from green to dark brown, and when at rest standing out rigidly, like many of the other span worms, so as to resemble a twig or the stem of a leaf. Neither of these latter caterpillars is a regular pest of the small fruit grower; but they occasionally appear in such numbers as to require attention. They are easily controlled by the same remedies as given above.

JAMES FLETCHER,
Ottawa, Can.

Currant Stem Girdler

Janus integer

After the leaves have fallen so that the stems of currant are well exposed many among them are sometimes observed to have been pruned off across the top, and by splitting the cane, a tunnel is found running down the pith chamber for from four to six inches. The excrement or frass of the borers is scattered along the tunnel and after early September the lower part of the tunnel will be found to have been cleaned out and is occupied by the grub, enveloped in a thin silken cocoon. A passageway from the center to the bark is eaten out and by means of this opening the adult sawfly, into which the grub transforms, makes its way to the outside the following May. The sawfly is a close relative to the insect which lays eggs to produce the well known currant worm. It has four wings, a shining black body, and light brownish legs. The abdomen of the male is brownish yellow, while in the female the first half of the abdomen is of a reddish-orange color and the rest is black. This insect is known as the currant stem girdler.

Remedy

By cutting off and burning about eight inches of the tips from the girdled canes, any time during the occupancy of the tunnel by the larva, the insect will be controlled.

H. A. GOSSARD,
Ohio Bulletin 233.

Currant Worm or Imported Currant Sawfly

Pteronus ribesii Scop.

By far the best known of all the insects which injure currants and gooseberries, is the "Currant Worm." The black spotted dark green false-caterpillars of this insect may unfortunately be found in almost every plantation of currants or gooseberries, every year in almost all parts of Canada. The white eggs are laid in rows along the ribs of the leaf on the lower side, towards the end of May. From these the young larvæ hatch and soon make their presence known by the small holes they eat through the leaves. Unless promptly destroyed, they will soon strip the bushes of their leaves, thus weakening them considerably so as to prevent them ripening fruit the first year, and also reducing the quality of the crop of the following season. There are at least two broods in a season in Canada. The first appears just as the leaves are attaining full growth, and the second just as the fruit is ripening. The perfect insect is a four-winged fly which may be seen flying about the bushes early in spring. The male is blackish, with yellow legs and of about the same size as a house fly, but with a more slender body. The female is larger than the male and has the body as well as the legs yellow.

Remedy

For the first brood a weak mixture of Paris green, 1 ounce to 10 gallons of water, may be sprayed over the bushes, or a dry mixture 1 ounce of Paris green to 6 pounds of flour may be dusted over the foliage after a shower or when the leaves are damp with dew. For the second brood Paris green must not be used, but white hellebore; this is dusted on as a dry powder, or a decoction of this powder. 1 ounce to 2 gallons of water, may be sprayed over the bushes. It is, of course, far better to treat the first brood thoroughly, so as to reduce the number of females which would lay eggs for the second brood.

Four-Lined Leaf Bug

Poecilocapsus lineatus Fab.

An occasional injury of no very great importance, as a rule, to the leaves of cur-

rants and gooseberries, is by the four-lined leaf bug. The eggs of this insect are inserted into the twigs of bushes, particularly currants. They are usually placed near the tips and protrude slightly through the bark. As they are white, they can be easily seen and, when once known, can be recognized again without difficulty. Much good may be done in controlling this insect by cutting off all egg-bearing twigs when pruning. The mature insect is a flat, bright green or yellow bug, with four black lines down the back and with the tips of the wings and two large round spots on the thorax also black. The nymphs or immature bugs occur with the adults near the tips of shoots and are exceedingly active. These insects puncture the young leaves of currant and gooseberry bushes as well as of many other kinds of plants, causing brown spots which are sometimes so numerous and close together as to make the leaves wither.

Remedy

When, as is generally the case, only a few bushes are attacked, shaking off the nymphs and perfect insects into open pans containing water with a little coal oil on the top, is often sufficient. If the attack is more extensive, spraying the bushes with kerosene emulsion or whale-oil soap solution will destroy all the insects reached by the spray. The winter is passed in the egg state, therefore, all egg-bearing twigs should be cut off and burnt.

James Fletcher,
Ottawa, Can.

Gooseberry Gall Midge. See under *Gooseberry Pests.*

Imported Currant Borer

Sesia tipuliformis Clerck (Family Sesiidae)

Aegeria tipuliformis Clerck.

General Appearance

The adult females are clear-winged moths with delicate, slender bodies about three-eighths of an inch long and a wing expanse of from five-eighths to three-fourths of an inch. The general color is jet black with deep blue iridescence. There is a yellow band around the base

Fig. 1. Adult Females of the Imported Currant Borer, *Sesia tipuliformis* (Clerck). The light-bands on the bodies are somewhat confusing, due to extremely bright light when the photograph was taken.

of the head; three distinct and two indistinct yellow bands around the abdomen and two oblique longitudinal yellow stripes on the thorax. Because of sunshine these lines and bands are misleading in the photograph (Fig. 1) excepting the last two abdominal rings in the left-hand specimen. The areas on the thorax just below the wings are also yellow. The fore wings are opaque along the borders, with a small band enclosing a clear area near the opaque tips which are bronze. The hind wings are clear, excepting a brown border. The legs are banded yel-

Fig. 2. The Pupae Cases of the Imported Currant Borer, from which the adult moths have emerged.

low and black with the inner sides of tibiae and tarsi yellow and the outer sides black. The larvae are slightly more than half an inch in length and yellowish white, with dark heads. The chrysalids are amber brown.

Life History

The eggs are deposited in the early summer and the young upon hatching bore into the canes of the currants and work upon the inner pith during the summer and winter, eventually destroying the bushes. Late in the spring the pupæ are found within the old burrows near an opening through which the adult emerges, drawing nearly all of the pupal case after it. The winter is passed in the larval stage.

Distribution

Canada and the United States.

Food Plants

The young caterpillars work on the pith within the stalks or canes of the currant and gooseberry, doing much damage to the fruit-bearing wood. In not a few cases entire patches have been rendered worthless before the unsuspecting grower was aware of the real cause of the dying bushes.

Control

Control is rather difficult and consists in cutting out and burning the sickly-looking canes as often as they appear.

E. O. Essig

Imported Currant Sawfly. See *Currant Worm*, this section.

Oblique-Banded Leaf Roller

Archips rosaceana Harr.

Late in May and during June the leaves at the tips of young shoots of currants of all kinds may be seen gathered together by active pale green caterpillars about three-fourths of an inch long, with black heads. Upon tearing the leaves apart these wriggle quickly out of their shelters and fall to the ground. When full grown, which is during June, the caterpillars change to brown chrysalids inside their tents, and from these a little later the moths appear. These are flat and broad in shape, resembling a bell in outline when at rest The front wings are light brown, crossed by broad oblique bands of a darker tint. The hind wings are of a pale ochre yellow. The moth expands about an inch across the wings. The caterpillars are very general feeders and may be found on a great number of trees and shrubs.

Remedy

Spraying bushes with Paris green and water to destroy the first brood of the currant worm, will control this caterpillar also, as it occurs about the same time. The clusters of leaves containing the larvæ are easily noticed and should be pulled apart and the caterpillars killed whenever detected.

Oyster Shell Scale

Mytilaspis ulmi L.

Several kinds of scale insects attack currants and gooseberries. These plants seem to be particularly susceptible to the attacks of the well known oyster shell scale of the apple, and the San Jose scale. In neglected plantations these injurious insects increase rapidly, and a great deal of injury results to the trees.

Remedy

The remedies for scale insects are direct treatment for the destruction of the infesting insect, and preventive measures such as the invigoration of the tree by special culture and pruning, to enable it to throw off or outgrow injury. Infested plantations should be cultivated and fertilized early in the season, and all unnecessary wood should be pruned out. As direct remedies, spraying the bushes at the time the young scale insects first appear in June with kerosene emulsion or whale-oil soap, or spraying in autumn before the hard weather of winter sets in with a simple whitewash made with one pound of lime in each gallon of water, gives the best results. Two coats of the whitewash should be applied, the second one immediately after the first is dry. In putting on two thin coats of the wash instead of one thick one, far better results have been secured. For the San Jose scale the lime and sulphur wash is necessary, and must be repeated every year.

"Red Spider"

Tetranychus species

In dry years great injury is occasionally done in plantations of currants and gooseberries, as well as on raspberries, apples and many other kinds of fruits, by various species of spinning mites which are usually spoken of in a general way, by horticulturists, under the name of "Red Spiders." These are all very minute reddish, or greenish white, mites that are found on the lower surfaces of the leaves, which they cover with a fine network of web in which they live and which renders it difficult to get at them with ordinary liquid applications. These minute creatures propagate very rapidly, and their injury to trees by sucking out the juice of the leaves is very soon apparent by the bleached appearance of the foliage, which soon dries up and falls away.

Remedy

It is probable that most of the kinds of "Red Spiders" pass the winter as eggs on the bushes. Plantations which have been infested one year, should be thoroughly sprayed early in spring with the lime and sulphur wash. Sulphur has a specially fatal effect upon all kinds of mites. If bushes are found to be infested in spring or summer time, they should be sprayed forcibly with kerosene emulsion, which might be followed in persistent attacks, which often occur, by dusting the bushes while wet with powdered sulphur by means of one of the so-called insect guns or horticultural bellows.

JAMES FLETCHER,
Ottawa, Can.

SCURFY BARK LOUSE. See under *Apple Pests*.

YELLOW CURRANT FLY. See *Currant Maggot*, this section.

Cytology

Cytology is the science which deals with the structure, development, and functions of the cell; of the multiplication of cells into organs and tissues. The cell has been defined as "A mass of protoplasm with a nucleus in it."

History of Cell Theory

Cells were first discovered in various vegetable tissue, by Robert Hooke, in 1665, but it was not until the beginning of the nineteenth century that any insight into the real nature of the cell and its functions was obtained. In 1846, Hugo von Mohl was the first to recognize that the essential vital constituent of the plant cell is a slimy protoplasmic mass, inside of the cell and not the cell itself. This mass was called the nucleus, and was distinguished from the cell wall which is now supposed to be a protection to the vital part, rather than the vital part itself.

The cell theory, in so far as it relates to plants, was established by Schleiden in 1838. He showed that all the organs of the plants are built up of cells, that the plant embryo originates from a single cell and that the physiological activities of the plant are dependent upon the individual activities of these vital units. This conception of the plant as an aggregate or colony of independent vital units governing the nutrition, growth and reproduction of the whole, cannot, however, be maintained. It is true that in the unicellular plants all the vital activities are performed by a single cell, but in the multicellular plants there is a more or less highly developed differentiation of physiological activity giving rise to different tissues, or groups of cells, each with a special function. The cell, in such a division of labor, cannot therefore be regarded as an independent unit. It is an integral part of an independent organism and, as such, the exercise of its functions must be governed by the organism as a whole.

Size of Cells

Prof. Charles Joseph Chamberlain, University of Chicago, says:

"Most cells are too small to be seen with the naked eye, cells which are visible without the microscope being exceptional rather than the rule. The egg of a bird consists of a single cell, as do the eggs of animals and plants. The largest plant cells are the internodal cells of the stonewort, *Chara*, which reach a length of two inches. The largest egg cell for any plant is that of the *Zamia*, a plant related to the sago palm; this

cell reaches a length of about one-eighth of an inch.

"The most usual shape of the free cells is the spherical, and cells forming a part of a tissue are more or less rectangular in form.

"When first formed, the cells of the individual animal or plant are very much alike, but as one examines the cell further from the regions where actual cell multiplication is taking place, it is seen that the originally similar cells are becoming very unlike. In the higher plants, the outer cells become differentiated into protective tissue, the innermost into conductive tissue, others into assimilative tissue, and still others become reproductive cells. In higher animals, similar differentiations take place, cells which finally become so different as those which form nerves, muscles, glands and even teeth, having been practically alike in the beginning. Among the unicellular organisms, there is often remarkable differentiation and division of labor, the single cell performing the functions of locomotion, securing food, digestion, assimilation, etc. Such differentiation and the causes which lead to it are among the most important cytological problems.

"It is a remarkable fact, that while undergoing nucelar division, the cells of plants and animals strikingly resemble each other, even in the behavior of the most remote constituents of nucleus and protoplasm.

"This must mean that animals have been derived from plants, or that structures of amazing similarity have arisen independently in animals and plants.

Fertilization

"Fertilization is one of the most important problems of cytology. While new individuals without fertilization, even in the more highly organized animals, may occur occasionally (by parthogenesis, chemical stimulus, vegetative multiplication, etc.) such cases are so rare, that fertilization is assumed to occur, unless its absence is clearly established. To the cytologist, fertilization consists in the union of definitely organized male and female elements. The cytological details of fertilization of plants and animals are essentially alike. Fertilization both in plants and in animals is preceded by a reduction in the number of chromosomes, so that the number of chromosomes found in the male nucleus or in the female nucleus is just one half the number found in the body cells of a given plant or animal. Consequently, when the two sexual nuclei fuse during fertilization, the number of chromosomes which characterizes the body cells is restored. The complicated details of the process by which this reduction in the number of chromosomes is effected is essentially alike in plants and animals. Those cytologists who have investigated most thoroughly the phenomena of fertilization have come to the conclusion that heredity is referable to a definite cytological basis.

A Cytological View of Heredity

"Almost without exception, cytologists have believed that chromatin is the physical basis of heredity. The reasons for this belief are briefly as follows: The male and female parents are about equally potent in transmitting characters to offspring; an equal amount of chromatin and an equal number of chromoses are contributed by each parent; nothing but chromatin is contributed equally by each parent. There is usually a great difference in size between the male and the female germ cells. The sperm cell (*spermatozoan*) of the ostrich, is almost invisible to the naked eye, while the egg is as large as a cocoanut, and such differences in size are usual both in plants and animals. The egg contains a large amount of protoplasm and various food stuffs and in many cases even that little is left outside at the time of fertilization, only the nucleus entering the egg. Hence, protoplasm and foodstuffs do not transmit hereditary characters. While the male nucleus is usually the smaller at the time of its entrance into the egg, it increases in size so that at the time of fusion the sex nuclei are alike in size.

"The organization of embryos and mature organizations from eggs is a cytological problem which has not yet been

solved. The visible stages in development have been observed and described *ad infinitum*. Both experimental cytology dealing largely with living material, and anatomical studies of thin sections, stained so as to show the most minute details of structure, are contributing to the solution of the problem, but the fundamental underlying phenomena are still unknown and seem as difficult as the problem of life. The eggs of the sunflower and the willow, like the eggs of flowering plants, are too small to be examined with the naked eye, but even when examined by the aid of modern technique and the most powerful microscopes, they present no essential difference in external appearance, nor in external structure, and yet one will always develop into a willow, and the other into a sunflower. Within the fertilized egg are all the potentialities of the adult, even to the color of the flower, or the markings of the wings of the butterfly.

"This view of Professor Chamberlain, is in substance supported by H. M. Bernard, an eminent French scientist, who in 'Some Neglected Factors in Evolution,' published in 1911, outlines his work as follows:

"'The cell, long considered to be the unit of organic structure, is here treated as a form-feature of a fundamental network universally present in protoplasmic tissues. The most primitive organisms are, essentially, living networks from which all the tissues and organs of the higher animals and man have become differentiated, in response to an ever-widening range of environmental stimuli.

"'The periodic rise in the level of organic life through the appearance of new types of animals, which the Darwinian theory of variation does not explain, is attributed to a series of units of structure, starting with one simpler than the cell. Each of these units in turn, by colony-formation, has succeeded in producing an organism of a more complicated type, and has thus inaugurated a new and higher evolutionary period. In man, the unit of the present period, the builder of human societies, the psychical functions of the organic living network, latent in former periods, have been developed by interplay with a psychical environment. The mental development of man and the complicated problems of social life are thus treated as being serial with the simpler phenomena of organic life and as pointing to some future higher development of the great Cosmic Rhythm.'"

DAHLIA. See *Floral Section*.

Dates

Phoenix dactylifera

The dates of commerce are the fruit of a species of palm, a tree which ranges from the Canary islands through Northern Africa and the southeast of Asia to India. It has been cultivated and much prized through most of these regions from the remotest antiquity. Its cultivation and use are described on the mural tablets of the ancient Assyrians. In Arabia, it is the chief source of national wealth, and its fruit forms the staple article of food in that country. The tree has also been introduced along the Mediterranean shores of Europe; but as its fruit does not ripen as far north, the European plants are used only to supply leaves for the festival of Palm Sunday among Christians, and for the celebration of the Passover by the Jews. The date palm is a beautiful tree, growing to a height of from 60 to 80 feet, and its stem, which is strongly marked with old leaf scars, terminates in a crown of shining pinnate leaves. The flowers spring in branching spadices from the axils of the leaves, and as the trees are unisexual it is necessary in cultivation to fertilize the female flowers by artificial means. The fruit is oblong, fleshy and contains one very hard seed which is deeply furrowed on the inside. The fruit varies much in color, size and quality, under cultivation. Those who only know the date palm from the dried specimens of that fruit shown beneath a label in shop windows, can hardly imagine how delicious it is when eaten fresh in Central Arabia. The dried fruit used

for dessert in European countries contains more than half its weight of sugar, six per cent of albumen, and 12 per cent of gummy matter.

Encyclopedia Britannica

The Date Palm in the United States

The date was early introduced into America by the Spanish. The history and present status of the date palm in the United States has been made a subject of study by the Arizona station. The following statements are taken mainly from a bulletin of that station. The palm followed the progress of Catholic missions from St. Augustine to Mexico, New Mexico, Arizona and California, where it is now grown in the open ground as an ornament as far north as San Francisco. The tree will, however, produce fruit only over a much more limited area. It is not yet grown on a commercial scale anywhere within the United States, though occasional seedlings are found in the desert regions of Southern New Mexico, Arizona, and Southeastern California, which produce fruit of excellent quality.

The greatest impulse was given to date growing in this country by the importation by the Division of Pomology of this Department of rooted suckers supposed to have been taken from female trees known to produce fruit of excellent quality. These were distributed and planted in Las Cruces, N. M.; Phœnix and Yuma, Ariz.; Indio, Pomona, Tulare, and National City, Cal. Of the trees thus planted it appears that 39 are now living, of which 15 have blossomed, seven of them being pistillate or fruit-bearing plants. It may be two or three years before their true fruit qualities can be ascertained.

The regions in which the date palm thrives are characterized by deficiency of rain and wide variations of temperature. The summer heat is intense, reaching 115° or more, though in winter the thermometer may fall as low as 16° below freezing. These climatic conditions are practically identical with those that obtain in the more southerly portions of the great Colorado desert. So great is the similarity in fact that, so far as climate is concerned, we may reasonably expect the date palm to fruit satisfactorily in the arid regions of our Southwest. Although the date palm requires exceptionally intense heat in summer, it will withstand in winter a temperature that would be fatal to the fig or orange.

Probably the soil best adapted to the date palm is one containing a small percentage of clay, fairly free from humus, and charged with alkali. Irrigation and heat are the all-important considerations. Water is indispensable. The roots should be moist at all times. "The date must have its head in the fire and its roots in the water" is an old Arabian proverb. The water should be applied frequently throughout the year, the most in the spring before blooming and in the fall prior to ripening of the fruit. Care should be taken not to irrigate too much at the time of blooming and just after, as this is liable to interfere with successful fruit setting. The water may advantageously be quite warm, from 75° to 95°, and contain considerable alkali. In midsummer irrigation should be in the late afternoon or evening to avoid scalding.

Palms may be planted along streams or flooded basins. All desert regions are characterized by occasional depressions where the water comes nearly or quite to the surface. During the rainy season these are filled with water and sometimes do not become entirely dry before another rainy season. The date palm thrives in such spots when once established, although its trunk may be partially submerged for some time. Where irrigation is practiced, however, water should not be allowed to rise above the surface of the soil for any considerable length of time, and later be allowed to dry away, as baking of the soil under these conditions may result in serious injury to the tree. From a study of the soil and climatic conditions in Northern Africa, where the date palm flourishes, it seems probable that dates may be grown in the region adjacent to the Salton basin west of Yuma.

The date may be propagated from seeds

or suckers. The former method is not much used except in originating new varieties, because, like many other fruits, the date does not come true to seed. The fruit is generally later and poorer, and the excessive number of males that spring up cannot be distinguished and destroyed until the tree blossoms, hence propagation by suckers is resorted to, although the date is difficult to transplant with uniform success. Frequently as many as 50 per cent. of the transplanted dates die after they have received the best of care, and if neglected hardly any will survive. The Arizona station gives directions for transplanting as follows:

Suckers may be removed at any time during the spring or early summer, or even in the winter if proper care be given them after removal. If they are to be planted in the open ground, it is advisable to remove them during the spring or early summer, April probably being the best month. In winter, when the plants are at a standstill, the suckers may be removed with comparatively small loss, if the bulbs be not less than four inches in diameter and have a few roots. It is necessary, when suckers are removed at this season, to set them in rather small pots, so that the earth, which should be given a daily soaking, may have a chance to get warm quickly. The pots should be kept in a greenhouse, or, better yet, embedded in a hotbed of manure, covered with the customary frame and glass. In all cases the leaves should be cut back to six to 12 inches in length. * * *

If proper attention can be given it is best to plant the suckers where they are to remain, as a second chance for loss occurs when they are planted in a nursery and later removed to the position that they are finally to occupy.

A two-inch chisel well sharpened, and an appropriate mallet, are the important tools to use in removing suckers. The leaf stalk should be cut away, exposing the bulb of the sucker, care being taken not to injure the bulb in removing. One should cut in rather deeply at either side, not being afraid of injuring the old plant, cutting out a V-shaped portion extending from the base of the bulb downward for a foot or more and being careful to secure in uninjured condition all the attached roots. If the position of the sucker be not too high above the ground, the V-shaped portion should be continued downward into the soil, that all established roots be obtained. The Pomona substation in California has the best success in removing suckers by banking earth about the stem of the plant so as to cover the bulbs a number of weeks prior to removing them. A good system of roots is established by this method of procedure.

Male and female flowers of the palm are borne on separate plants. In the male plant the flowers are crowded closely together on a large branched panicle and have an odor like musty flour. If the panicle is shaken when the flowers are well opened quantities of pollen will escape, filling the air as if with dust. The flowers in the female panicle are much farther apart; the segments are smaller and less spreading. The center of the flower is well filled by three pistils, two of which soon become abortive.

It is evident, then, that male and female trees should be planted near each other. It is quite common to set one male plant in the center of an irregular circle of six or eight females. If the trees are planted in a row along a roadside the male trees should be planted to the windward. The wind may be depended upon as a rule to effect pollination if the staminate is not more than six or seven rods from the pistillate flowers. At greater distances pollination may be effected, though with doubtful certainty of completeness, by both wind and bees.

The palm is peculiar in that the pollen retains its fertility for a long time. It may be transported to great distances and artificially applied to the female blossom with success. Pollen should not be dusted on the flower too profusely, as overpollination is said to weaken the developing dates and cause them to drop from the tree. When artificial pollination is necessary the male blossom is cut from the tree as soon as the cracking of the spathe shows that it is about to open. The panicle may then be cut into pieces

and a piece tied near the opening of each female panicle.

The date palm, whether male or female, varies greatly as to time of blooming. It always blooms late, however, thus escaping injury from late spring frosts. In Arizona the blossoming period begins about April 15 and continues six weeks or more. In planting male trees suckers should be selected from those that blossom earliest and most profusely and continue in bloom from three to five weeks.

The varieties of dates are almost innumerable. They vary greatly in size, color, sweetness, delicacy of flavor, and length of time required to mature. The dates of commerce are usually light colored, these being of firmer texture, and are hence preferable for shipping purposes.

The average yield of a tree is eight bunches, each weighing about 17½ pounds, though they may weigh as much as 44 pounds. In Arizona seedling trees seven years of age have produced upwards of 200 pounds in a single season. Young trees blossoming the first or second time should not be allowed to bear more than four or five bunches.

Among the various enemies of the date, birds and bees do much injury by feeding on the ripe fruit. Cheese cloth sacks loosely inclosing the bunches on the tree afford the best protection. The expense should not exceed 10 cents per tree. Grasshoppers do much damage by feeding on the foliage. The most serious pest that the date has in this country is a scale insect that was imported on palms several years ago. The insect is small, but conspicuous against the dark green leaves, both sides of which are infested. The Arizona station has not yet discovered any means of eradicating the pest. Applications of whale-oil soap washes and fumigation with hydrocyanic-acid gas have been only partially successful.

Office of Experiment Stations, U. S. Department of Agriculture, Bulletin 92

Delaware

Delaware has a land area of 1,257,600 acres, and with the exception of Rhode Island, is the smallest state in the union. It has a population of 202,322, a large percentage of which live in manufacturing centers. There were reported in 1909 10,836 farms which give a fairly good estimate of the number of farmers. The average number of acres per farm is 95.6, and the average value of farm land per acre is $33.63.

The soil and climate are not much different from those of New Jersey, or any of the portions of country along the Atlantic coast. There is in the soil a considerable mixture of clay and sand with some humus, which renders it adaptable to the growing of fruits, melons, potatoes and vegetables. The waters also furnish reasonable protection from frosts. It has been supposed that Delaware was especially adapted to the growing of peaches; and some supposed it would soon become a great peach orchard; but at the time of the largest hopes in this direction, the "Peach Yellows," a disease not well understood, struck the orchards and thousands of acres of trees were dug up, while the planting was in a considerable degree checked. According to the census of 1910 Delaware had of peaches and nectarines 1,177,402 trees; apples, 429,753; pears, 449,692; grapes, 260,936 vines, and strawberries, 7,194 acres. In 1909 the production of all orchard fruits together was 65 per cent less than in 1899.

For market facilities, there is no state more favorably situated than is Delaware. Of the total value of crops in 1909, 51.4 per cent was contributed by cereals, 21.1 per cent by potatoes and vegetables, 12.9 per cent by hay and forage, and 15.6 per cent by small fruits, forest products, orchard fruits and nuts.

Granville Lowther

Progress in Apple Growing in Delaware

Progress in apple growing in Delaware in twenty years is from practically nothing to a respectable crop. To realize just what has been done, a comparison must be drawn between then and now.

Then a few venturous spirits had been making excursions into the unknown by planting any variety that any one recommended. Out of that hodge podge of planting had appeared some few varieties seemingly well adapted for use here, but

mostly Delaware orchards were the relics of the tree agent age when the glib tongue and beautiful pictures of fruit sold trees well adapted for planting in the north but worthless for this soil and climate. Remnants of these orchards still exist in many localities With these were found a few varieties like Winter Grixon and some of the earlier sorts, good enough in themselves at that date for local consumption, but none of them free enough of scabs, blights, rusts and worm-holes to have commercial value. Men who know, said that good, clean fruit had been grown here, but for some reason would not grow any more. No market existed for the stuff that was grown, for none were so poor as to do it reverence. When a little start had been made and more good fruit was raised than local markets could consume, it was uphill work to convince buyers for the large markets that Delaware could produce any apples suitable for their trade.

Today Delaware ranks high in production per acre and per tree; and year by year advances in quality and quantity.

S. H. Derby,

Address before 24th Annual Session of the Peninsula Horticultural Society, Dover, Del., January 10-12, 1911.

Fruit Crop of Delaware

The fruit crop in 1910 amounted to 20,000,000 quarts of berries; 750,000 bushels of apples; 500,000 bushels of peaches; 631,000 bushels of pears; 279,000 carriers of cantaloupes; 373 carloads of watermelons.

Dehydration. See *Evaporation of Fruits*.

Dewberry

The dewberry is one of the most luscious of the small fruits. It has a fine flavor, and is rapidly growing into popularity. It requires about the same care and treatment as the blackberry, but is a little more tender, and in the colder regions it would be necessary to protect the canes by a light covering of earth or straw, during the winter. Its habits of growth are somewhat different from those of the blackberry. The blackberry is an upright grower while the dewberry is a trailing vine and is usually trained on trellises

Card, in his "Bush Fruits," doubts the value of the dewberry, and suggests that its place may be occupied with some improved varieties of blackberries. This may be true, on account of the dewberry being a poor shipper. It must be in the market not less than 36 hours after picking; but for early ripening and flavor, we have no blackberry that is its equal.

Soil and Location

In its wild state, the dewberry is found growing on light sandy soils; but experience has shown that any soil adapted to raspberries or blackberries will grow dewberries successfully.

Granville Lowther

Dewberry Culture

Propagation

The dewberry may be propagated by layering the tips or from root cuttings. In fact the plants are so easily secured that one may generally get them from his neighbors' plantation more easily than from a nurseryman. If plants are required by the wholesale a good plan is to plow a furrow along the row, place the tips of the runners in this and turn a light furrow back upon them; the tips must be actually covered. This work should be done before the opening of the picking season in most altitudes, and the plants will be ready for next spring's setting. Deep cultivation that will disturb or break large roots will cause many new plants to start. If an old bed is to be discarded, a good crop of plants may be secured by thoroughly plowing and working down the bed in the spring, allowing the young plants to spring up from the broken roots the following summer. Root-cuttings, from roots the size of a lead pencil, may be taken in the fall, stored in moist sand over winter and planted out in nursery rows the following spring. If these root-cuttings are well cared for during the winter and planted three inches deep in a good soil, kept well moistened, a fair per cent will produce plants. Root-cuttings taken in the spring and planted in the same way will also give fair results. The

dewberry does not sucker as freely as the blackberry, neither does it root as readily from root-cuttings.

Preparation of Land for Planting

In an irrigated section the first step in the preparation of land for any crop is proper leveling; low spots where water settles or high spots difficult to irrigate materially cut down the dewberry yield. Best stands are secured when the ground has been deeply plowed, well worked down and pulverized; no doubt fall preparation is advisable for spring setting.

Planting

The majority of our dewberry beds are from spring settings but many of our experienced growers seem to be of the opinion that fall setting would prove as satisfactory and would bring quicker returns. I see no reason for not setting in the fall, the plants would necessarily be quite tender the first winter but could be well protected and should suffer no injury. Planting in the fall should be done in early September and spring planting as soon as the ground can be worked. As to distances for planting there is still some dispute, but, if the plants are to be allowed to grow prostrate, setting 5x5 feet seems to be the most satisfactory system. They can be pruned accordingly and cultivated either way. If grown on a wire trellis, rows six feet apart with plants three feet in the row would no doubt be a better system. When planted in the young orchard, the distance can be made such as to best utilize the space. There is no particular objection to planting dewberries in the young orchard but the grower is to be cautioned about crowding the trees and advised that in most cases it is not a crop for the old orchard.

For planting, the ground is furrowed out one way and cross-marked. The plants are dropped in the furrow at its intersection with the cross-mark, and partially covered with the foot. The furrow is turned back, the plants straightened up, the soil firmed about them, and the job of setting is completed by running water down the row. As with any other plant, the top should be cut back at setting time to offset the loss of roots in digging.

Cultivation

The cultivation of the dewberry patch should not be unlike that for any other bush fruit. It should be well cultivated in the early part of the season to keep down the weeds and conserve the moisture. Cultivation stops at the opening of the picking season and is resumed again at its close, continuing until the end of the growing season. Since deep cultivation which disturbs or breaks the roots tends to start objectionable plants in the middles, the early cultivations and possibly the later ones should be rather shallow. If the plants are allowed to run for the purpose of being trained on a trellis, cultivation must be in one direction; when checked equal distance each way the general plan is to keep the middles open only one way. While it may be possible to overgrow the plants by continual cultivation, it is better to counteract this by withholding water rather than by discontinuing cultivation. Good cultivation is no doubt conducive to vigorous, but not necessarily to rampant growth.

Irrigation

There are really no tricks in irrigating dewberries. The ground should be kept moist and in good condition during the early part of the growing season. The young plants will stand a good deal of water the first season. During the picking season it is the common practice to water after each picking, just a light surface watering. This supplies the roots with the needed moisture to swell the berries to good size and by keeping the surface of the ground moist the berries ripen better, there is less loss from the drying of the fruit. It would be a good plan, no doubt, to try to induce early maturity of the canes by withholding water after the close of the picking season. In localities where the winter snowfall is not great the dewberry patch should be given a late fall irrigation.

Fertilizing

The grower of dewberries cannot expect that the plants will continue bearing good annual crops without fertilization. If properly cared for, there seems to be almost no limit to the duration of the

plantation. Good stable manure is one of the best fertilizers. It may be applied in early spring before uncovering the plants and the uncovering process as well as early cultivation will help incorporate it with the soil. Frequent light applications are preferable to heavy and irregular ones, as they tend to promote more uniform growth and yields.

Pruning

In most sections dewberries are allowed to grow prostrate; growers say it is too expensive to trellis them and it might be added that the present system seems highly satisfactory. No doubt, under certain conditions, trellising would be advisable but surely could not increase the yield any considerable amount. Where the plants are grown on a trellis, they receive no summer pruning as a rule; the new canes are allowed to trail on the ground under the trellis while the fruiting canes are tied to the wires. The only pruning the plant requires—unless it be a clipping back in August to induce early maturity—is cutting out the old canes in the fall or spring and shortening the new ones to three or three and one-half feet. A two-wire trellis is generally used, the top wire being about three feet from the ground. The training of the dewberry without the trellis requires a little more care in pruning but saves the labor of tying up and allows of early cultivation either way. The first pruning consists in tipping the new growths when they have attained a length of 12 or 18 inches; the canes then stand upright above the old wood and the tips may be mowed off with a sickle or large knife. It is important that this pruning be done at the right time; do not wait until the canes are longer and then cut back to eighteen inches or weak lateral canes will be the result. This early pruning forces out lateral canes and thus increases the bearing surface as well as stiffens the lower part of the cane, making it support itself better. The general practice is to prune the second time just before picking begins. The main object of the pruning seems to be to get the new wood out of the way of the pickers. At this time the lateral canes forced by the first pruning are cut back to two or two and one-half feet; they should be left long enough to shade the old wood and the fruit, yet short enough to be easily lifted by the pickers. This pruning must not be delayed too long as it starts new growth which should have time to mature. At its best it is not satisfactory and it is probable that the growers will yet learn to avoid this pruning. The third pruning is administered the following spring, and consists in removing all old canes and shortening in the new canes that may have grown too long. There seems to be no reason why this pruning may not be done before covering in the fall other than that the foliage makes the pruning more difficult.

Picking

In growing dewberries on a large scale one of the serious problems is that of securing pickers. The average picker will pick from five to seven crates a day, and this means that it will take from eight to ten average pickers to pick an acre per day. The general practice is to pick every third day, and the large patch may be divided so as to furnish the pickers employment every day.

The pickers must at least wear a glove on the hand used to lift the vines and most of them wear a glove with the tips of the fingers removed on the picking hand. Some growers supply the pickers with a twelve-basket carrier, or two if the pickers are fast and able to carry them. Others advocate the use of the regular shipping crate holding twenty-four baskets. A bale may be made of heavy wire bent in a way to clamp into the grooves that serve as handles in the end of the crate. Of course crates used to pick in cannot afterwards be used as shipping crates. The deck boards and baskets for the second tier are carried along and placed in position when the first tier is filled. In this way the picker carries a full crate in one hand and at the same time does not expose them to the sun for any length of time. A piece of heavy cloth large enough to cover half the crate may be tacked by two corners

across the center of the crate and used to shade one end of the crate while the other is being filled. The pickers should be made to grade the fruit, and the best way is to have them put the culls in certain boxes and pay them for picking these the same as first class fruit. This plan provides a place for fruit the picker gathers and hates to throw away because it fills up. Dewberries should be picked when a full glossy black. Berries which have gone beyond this stage and turned a dull or more ashy color are too ripe to ship. The cull box is the place for overripe, dry, and poorly colored berries. Ripe berries start mold if packed for shipment.

Dewberries should not be picked when moist, as after a heavy dew or rain. Pickers are paid by the crate, thirty cents, if they pick part of the season, and thirty-five cents if they finish the season. If the grower does not protect himself in this way, some of the pickers will leave him when picking gets poor.

Yields and Returns

A dewberry plantation in good bearing will yield from three hundred to four hundred crates of berries per acre. Mr. Baldridge's patch, on four and one-half acres of ground was set in 1903. In 1904 it yielded 125 crates of berries, in 1905, 1,800 crates; in 1906, 1,800 crates and in 1907, 2,000 crates. It would probably be hard to give a satisfactory estimate of the cost of production of dewberries. The crate costs the grower 27 cents and picking 35 cents per crate, plus probably 5 cents for overseeing and crating the fruit. At present (1909) the average price paid for dewberries has been $2.25 per crate F. O. B. the nearest shipping point.

O. B. WHIPPLE

Colo. Exp Sta. Bul. 136

Varieties

[Only three varieties are recommended by the American Pomological Society for propagation, the Lucretia and Mayes or Austin-Mayes having proven successful and the McDonald, which is recommended for trial.—Ed.]

DEWBERRY DISEASES

The dewberry is troubled by the same fungus and other diseases, for the most part, as the raspberry and blackberry. The reader is referred to the diseases of these plants.

Double Blossom

Fusarium rubi Winter

A disease known as "double blossom" occurs on several species of *rubus;* but has attacked the Lucretia dewberry especially. It has been reported from the Middle Atlantic states and westward to the Mississippi, having first attracted attention in Illinois.

The disease produces witches' brooms on the buds which sometimes remain green after the canes are dead. Diseased buds show larger than normal in the spring and are frequently of a reddish color.

The outer flower parts are increased in number and appear crumpled while the ovaries fail to develop fruit. Soon after the opening of the flower buds the fungus fruits and the spores falling upon young buds germinate and grow inward. The fungus remains dormant here until the following spring.

Hand picking of the diseased buds is the most practicable method of control at present known.

Reference

M. F. Cook, Delaware Experiment Station, Bulletin 93.

DEWBERRY PESTS

The dewberry is attacked by much the same species of insects as other members of the Rubus family. See under *Blackberry and Raspberry Pests.*

Diseases of Plants

Origin and Nature of Disease

All diseases originate from one of two sources. First, the nature of the organism in which the disease is located. Second, the nature of the environment, which is something outside of the organism and to which it is closely related.

Whoever would, therefore, understand disease, must know something of the organism in which the disease is lo-

cated, the environment and the relations between the organism and the environment. It is often difficult to distinguish between health and disease; because of the differences between the standards by which comparisons are made. For instance, whoever has seen an oak in the Appalachian mountain range, where it is "King of the forests," and would compare it with the same species and variety found in the semi-arid bluffs of Kansas and Nebraska, would incline to the opinion that the stunted specimen of the semi-arid section is diseased. However, the short, scrubby specimen of the Central West is normal to that region and not diseased. It may be pointed out that certain specimens of that region are decaying, have been attacked by insects, broken by storms, are not properly nourished, the leaves turning yellow, and that these particular specimens are diseased while the normal specimens, with no visible decay, no external injuries and no apparent lack of nourishment, are healthy. Prof. A. D. Selby, Botanist of the Ohio Agricultural Experiment Station, says: "The idea of disease is not an easy one, though it may seem so before trying to define it. In reality, the term disease as applied to plants means any change in the plant towards reduced vigor from the ordinary behavior. To put it in another way, a plant is said to be diseased when it shows deviation from the average behavior of the plant in respect to appearance, growth, color of bark, foliage, fruitfulness, time of dropping the leaves, or length of life. In short, when the plant fails to perform those functions, or conform to those averages which have been established by observation for the species and variety in question, we say that it is diseased. Under such general definition, variegated or purple hued spots would be included, although diseased potentially rather than in reduced vigor."

In deciding the question of what are favorable and what are unfavorable conditions results obtained from experiments or from observed phenomena would be determining factors as against any theory. The best conditions would be those in which the best specimens were produced; average conditions would be those in which average specimens were produced; and poor conditions those under which poor specimens were produced. By observations of this character, it can be determined what environments are most favorable for the health and vigor of the plant. In this manner we have come to know in a measure what are the conditions best suited to the different varieties of apples, peaches, pears, plums, grapes, strawberries and bush fruits. We have by a general study of the subject, by information gathered from all available sources, from farmers, experiment stations and experts who have traveled widely, made comparisons so that there is a general ideal or standard of judging, by which plants are compared and the plants of normal growth, excessive growth and stunted or diseased conditions determined.

It would seem that a comparison should not therefore be made between the most perfect specimens and any particular individual of the species, nor should it be made between the more stunted specimens and the same individual, but with the average, for it is the great law of averages that determines the standard of any race, species or variety.

Perfection as a Standard

We have often urged that perfection should be the standard by which comparisons are made, and we still insist on this when we are trying to improve the stock. But judging in reference to diseased specimens is another matter. Perfection is defined as "Having all properties and qualities necessary to its nature, of the best, highest, or most complete kind of type, without deficiency, fault or blemish." Sometimes it is defined as "Finished, incapable of being improved upon." In this latter sense the word is never used in reference to fruits, for like most other things in nature, there is no limit to the degrees of improvement. The apple of the future will perhaps be as much better than the apple of today as the finest specimens

of Spitzenburg are now better than the forest crab, from which they probably came. Perfection is therefore a relative term, in the same sense that disease is a relative term, and a just comparison can only be made with the average. That which is now considered perfection may be very imperfect in the future, and that which is now a standard of health may be considered stunted, because it may fall below the average

Nature of the Organism and Disease

There is much more knowledge than formerly upon the nature of organisms and their adaptations to particular localities. It is understood that no two things in nature are exactly alike; but several things, like apples, for instance, are sufficiently alike so that the conditions necessary for the growth of one variety may be favorable for the growth of another variety. Still, it remains true, that the different varieties of apples are in many particulars unlike, and that the unlikeness is sufficiently marked so that conditions favorable for the growth of one variety may not be the best for another, and in some extreme cases are decidedly unfavorable. This is the reason why the American Pomological Society has divided the United States into districts and has given a list of the various fruits and their varieties that are "Successful, very successful, fairly successful and recommended for trial," in the different districts. (See page 192).

We will compare a few plants that belong to different species, rather than those of the same species, as illustrating our idea. Take celery, cress and cranberries as illustrations of plants that require a great amount of water. In a dry soil, where the sun was hot, they would sicken and die. On the other hand, almonds, sand-plums, sage brush and cacti would reach a normal condition and manifest health where the first named group would die. This is on account of the nature of the organism, which adapts one to a wet soil and the other to a dry soil. Because of this difference it would be folly to expect success in the growing of celery without plenty of water, or to expect success with almonds in a damp or sub-irrigated soil.

All Plants Once Aquatic

It is taught by geologists that in the early history of our globe the whole surface of the earth was successively covered with water, and that all vegetable and animal life was adapted to the water. With the changes that came from the shrinking of the surface of the earth, the consequent upheavals, the building of mountain ranges and the valleys between them, the subsequent draining of great basins of lakes and seas, and the consequent forming of deserts it came about that gradually both plants and animals became adapted to the many conditions existing between the extremes of water and desert. The struggle of all forms of life is for existence and the tendency is in the direction of those changes necessary to existence and to adapt the organism to a given environment. The plant that cannot become so adapted will in so far as that particular locality is concerned, become extinct. Naturally, therefore, the plant or tree that is adapted to the desert will have a small leaf surface, from which little water can be evaporated, or if the leaf surface is large as in the case of the cacti, it must have few stomata, or pores, from which the water can be taken by the action of the heat. It must also have a root system, adapted to the dry soil conditions under which it lives. Another example of the leaf formation in adaptation to the different conditions is the difference between the Indian corn and the Kaffir corn. The latter having a thick, compact leaf with few cells exposed to the air and which admits of a small amount of evaporation, lives in dry regions. For this reason certain varieties of peaches will live and bear fruit where other varieties would die, and watermelons will grow successfully where pumpkins and muskmelons would fail. It has, therefore, come to be observed, that plants have certain likes and dislikes, growing out of the nature of the organism, and that if any particular plant gets what it likes it is healthy, but if it does not, it becomes diseased.

Organs Have Become Permanent

Whatever may have been the causes of variation in plants, the facts remain that they are variously adapted, and that these adaptations are suited to all the conditions common on the surface of the earth. This has made necessary organs that mark them as different, performing different functions in different degrees, and these differences have become permanent. Therefore, unless these permanent likes and dislikes are considered, the wants growing out of them supplied and they are protected from that which they dislike, there cannot be a condition of health. For this reason it is necessary to study the nature of the organism and the nature of the environment It is only by this means that it can be determined whether they are adapted to each other, or whether the soil, climate and general surroundings contain injurious elements. If a certain soil, for instance, contained all that was necessary to the health of a tree, but if at the same time it contained something injurious, the tree would suffer; as in the case of a man who ate a good healthful meal containing all that was necessary to his vigor, but at the same time took poison. Again, it is often true that certain chemical qualities in the soil are good in certain proportions, but taken in larger portions become injurious. This is true of alkali salts, which in a certain degree are fertilizers, and stimulate the growth and vigor of fruits and other crops, but in larger quantities, become injurious. In certain excessive quantities they kill the little hairs that form on the roots and which gather the food substances in solution, thus causing a lack of nourishment and final death of the plant. The symptoms are generally a yellowing of the leaves. If we may judge by the unfavorable conditions under which plant life has been observed to grow, we might conclude that there is life potentially in every particle of earth, air and water. In other words, that life is everywhere, and that it strives to clothe itself with whatever forms are adapted to its surroundings. Whoever has observed the growing of moss on the rocks in the desert or on a marble slab in a cemetery, must have wondered at the tenacity with which life struggles to maintain itself, and with which it strives to adapt itself to the most unfavorable conditions. Yet, it would be folly to plant a tree in the solid rock or try to grow a garden on a marble slab. We must, if we succeed, study the nature of the organism and the environment.

Health the Normal Condition

Whatever may be the cause or causes of diseased conditions in plants, we are forced to the conclusion that the tendency of life is toward health and toward a more perfect expression of its being. Among the many proofs that may be offered are the following:

First. The tendency of all plants to change, in order to become adapted to different conditions of soil, climate and whatever environment affects them.

Second. The effort to repair any injury that has been done by insects, animals, wounds, diseases or from whatever cause.

Diseases Classified

We give herewith a general outline under which diseases may be classified.

1. Secretional diseases, in which cellulose is transformed into gum, resin, manna. The effect is produced by overaction of the normal functions.
2. Diseases produced by fungi and other vegetable parasites.
3. Diseases produced by decomposition, as gangrene, or canker. These are processes of decay in which the cellulose is transformed into a muddy fluid, a brown powder, or a carbonaceous mass.
4. Diseases produced by the attack of insects and other animals.
5. Atmospheric conditions.
6. Soil and moisture conditions.
7. Light, electricity, winds and storms.
8. Crowding so that the food supply is cut off.
9. Isolation and consequent lack of fertilization.
10. Unknown causes.

GRANVILLE LOWTHER

History and Definition

Diseases in plants have existed as long as plants themselves—ages before the advent of man. Civilization and agriculture have usually developed together in all parts of the earth and it is not strange that anything that troubled or destroyed an important food plant should be observed and the cause sought. In the earliest historic records as well as in early Greek and Roman times some of the more destructive diseases of plants, like rust and mildew or blight of cereals were widely known and discussed. A special deity was recognized who ruled these phenomena and to whom sacrifices were offered.

Injury due to animals, especially insects, and to extremes of weather and unfavorable soil conditions were early often associated with their appropriate causes. It was not, however, until the latter part of the eighteenth and the beginning of the nineteenth century that the solid foundations of plant pathology were laid by the development of anatomy and physiology. The early works of Unger, "Die Exantheme der Pflanzen," etc. (1833); Weigmann, "Die Krankheiten und Krankhaften Misbildungen der Gewasche" (1839); and of Meyen Pflanzenpathologie" (1841), marked an important step forward in the embryo science of plant pathology. During this period microscopical, chemical and physiological work with plants was active. The writers of this period rather overworked unfavorable nutrition as the cause of disease. Maladies that could not be traced to visible external causes were usually held to be due to unsuitable nourishment or the lack of something in the soil. It was not believed that the fungi so often found associated with diseases had any casual relation to them. They were held to be abnormal developments of the diseased cells themselves and not independent organisms. It remained for De Bary to determine the true nature and habits of fungi and bacteria and to demonstrate their causal relation to disease in many cases. His careful work gave a great stimulus to investigation in plant and animal pathology and opened what has proved to be the most important field of the science. His two most important works are "Untersuchungen uber die Brandpilze," etc. (1853), and "Morphologie und Physiologie der Pilze," etc. (1866). Since De Bary the rapid development of the subject is well represented by the works of Hartig (1874-89), Frank, (1880-96), Soraurer (1886-8), Marshall Ward (1889-1901). The last work "Diseases in Plants," is one of the most excellent and readable expositions of the subject that has appeared.

Health and Disease Compared

That there is no defined line between health and disease is generally recognized by pathologists and physiologists. A plant continually varies in response to changes in its environment. There is, however, for each individual and for a given species as a whole a certain accustomed range or power of adaptation to each factor of its environment and to the various combinations of these factors. The process of natural selection operates to perfect this adaptive attuning of the individual and the species as a whole to the conditions under which they live. If these conditions are subject to great extremes of moisture and dryness or heat and cold, the natural or indigenous vegetation will be found, as a rule, equal to the emergency, while an introduced species, if developed under an environment not subject to such extremes, might be seriously injured or destroyed, and if the change is very unusual even the indigenous species may suffer. A moist, warm, cloudy spring may be followed by dry, hot weather and the tender watery growth be so much dried out and checked that it may be deformed and abnormal in shape, structure and size. This variation may be slight or it may be great. If it is slight it may have no appreciable effect on the vigor and growth of the plant. The leaves become a little firmer and smaller and more resistant to the hot, dry conditions, while the maturer leaves that cannot adapt themselves to the change turn yellow and fall, cut off by the parent plant. The plant is better for

the change and can live under the modified conditions with greater ease and safety.

If the variation is greater, the growth of the plant may be decidedly checked, the leaves being small and many more of them shed. In still more extreme cases the tender leaves may be dried up and killed either wholly or in part. According to Hartig, "It is only when the sickly condition leads to the death of some part of the plant that we may speak of actual disease." Where a few leaves, unable to adapt themselves to a changed condition, turn yellow and fall, the leaves themselves may be diseased, but the plant as a whole is benefited by their loss as being relieved of sources of uncontrolled drain of its water supply. As the loss of leaves becomes greater, however, we pass from the extremely localized disease to a point where the whole or a considerable part of the plant is weakened, either by the direct loss of food that should be furnished by the leaves to the rest of the plant structure, or by the use of reserve food in the reproduction of lost parts. It is evident in such cases that the border line between health and disease is hard to define. The case is not much easier if, instead of variations produced by moisture and temperature, we consider those caused by insects or fungi. A few leaves eaten from a tree by some insect or destroyed by a fungus might have no injurious effect on the tree as a whole, and might even be an advantage, but as the number of injured leaves increases the tree is weakened and its life threatened. Slight doses of certain poisons stimulate the cells to more vigorous growth, acting as a tonic, while a little larger dose poisons and destroys the cell. Leaving all questions of consistency of definition, we may practically define as diseased all those conditions of a plant which directly or indirectly endanger its life or prevent normal development under given conditions of environment. Or, as Marshall Ward puts it, "We may define disease as dangerous disturbances in the regularity, or interference with the completeness or range of the molecular activities constituting normal life—that is, health—and it is evident that every degree of transition may be realized between the two extremes."

Prevention

Successful treatment of plant diseases consists in preventing the spread of the disease and not in curing the plants already affected. The tiny thread-like plants—the *fungi*—which cause diseases, grow inside the tissue of the leaves, stems, fruit, etc., of the plants, which they attack, and after they have gained entrance there it is impossible to reach them or to treat the tissue which they are destroying. These fungi perpetuate themselves by producing myriads of tiny seed-like reproductive bodies—*spores*—which are so tiny as to be invisible and so light that they float about everywhere in the air. They are thus carried from one plant to another by the wind, and where they lodge on a leaf or stem and find conditions favorable they germinate and grow. Disease is thus scattered from plant to plant and from field to field. These spores are always produced on the diseased areas of affected plants, and for this reason where it is possible to do so all diseased parts should be collected and burned as soon as the disease appears on them. If this could be done with all plants and all diseases they could be eliminated at one clean sweep. Unfortunately, some of these fungi live over in the soil or in fragments of decaying plants, which cannot be collected by any practical means. In such cases we have to resort to other means of controlling them. One way of doing this is by using disease resistant varieties. Certain individuals and certain varieties of plants are more resistant to disease than are other individuals and varieties. By planting seed from such individuals, and by continually discarding the plants which succumb to the disease, we originate a disease-resistant strain or variety. In some cases this is simple and can be practiced by any one; in other cases where the plants, such as trees, are long-lived, and we have to wait a long time for results, it is objectionable, and we have to resort to some more artificial method, such as spraying.

Spraying usually gives immediate but temporary relief. It is the method, however, to which we must resort at present in order to control the large majority of plant diseases. The principle of spraying depends upon the fact that these fungi are more delicate and more easily killed by poisons than are the plants on which they grow. The object is to use some poisonous solution which will not injure the plant that you are "doctoring," but will kill the fungus parasite, or if applied as a preventive, will prevent the fungus from entering the host plant. For instance, if a plant is covered with copper sulphate or some other poisonous solution the spores, which lodge on its leaves and stems, cannot grow and produce disease but will be killed by the poison. In this way plants are protected. In this connection, too, we can readily see the necessity for making the spraying thorough. Fungus spores lodging on exposed surfaces would germinate and grow directly into the leaf or stem, and actually undermine the neighboring surfaces, which might be thoroughly coated with the poison. So spraying in order to be effective must be done in such a way that every particle of surface of the susceptible part of the plant is covered. No possible exposed place should be left on the leaves or the fruit or the stems where the fungus could, perchance, enter.

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Saving Trees by the Use of Cement
How the Tree Surgeon Stays Decay with Cement Fillings

In our minds disease and suffering are so closely associated that we ordinarily regard the allaying of pain as the fundamental function of medicine and surgery. We are apt sometimes to overlook the economical gain to the community which the maintenance of health among its members implies. The economic factor is of course quite prominently displayed in veterinary practice, though here also there is pain to be alleviated. When we come to the vegetable kingdom the purely "benevolent" motive for medication is practically absent. This, perhaps, is the reason why we hardly class plant surgery in our minds in the same category as the treatment of human and animal ailments. But while there is thus a pronounced difference in the two fields, in most other respects they are very similar.

The plant, like the animal, is a living thing, subject to the attacks of enemies in life and ultimately to death. Like the stricken animal, also, the diseased plant is ready to receive at the hands of man beneficent medical or surgical treatment. And in plant surgery, as in the practice of the art on the human being, a species of asepsis is essential for success.

In the science of plant medication quite an important role is played by cement. This material has, in the practice of tree surgery, a definite, well defined purpose, and certain fixed methods of application. This does not mean that all trees should be treated alike. This is obviously impossible. However, there are certain principles which must be incorporated into each cavity, and these principles are the same for each case.

In order to understand the use of cement in trees we must understand the purpose of the operation and something of the life's processes of the tree. The inside of a tree is practically dormant, except the few layers of woody fibers just under the bark. The sap ascends in these outer woody fibers, and enters the leaf, where it undergoes the chemical change which produces the "tree-food." This tree-food descends just underneath the bark, building as it goes. It continues to descend and build until it reaches the tiniest roots. Thus we see a real circulation in the tree. The central tissues serve no purpose save that of physical support. If any other substance can take its place and accomplish the same result, the tree will continue to live and thrive indefinitely, provided the new center of the tree is sealed tight to the adjoining tissues and remains so. The real life of a tree is represented by the bark, the cambium layer just behind it, two, three or four inches of sap-wood just behind the cambium, the leaves, and the roots. If these parts are vigorous, it makes little

or no difference whether the center is wood or stone.

The bark is a protection for the tree. Where the bark remains intact, the woody fibers of the inside are preserved for generations and for centuries, unless some outside agency kills the tree. Destroy any part of the bark by any means whatsoever, and when the protection is gone the wood decays. Once decay secures a start, its progress is rapid. It continues until checked by artificial measures or until the tree becomes so weak that it is blown over in a windstorm. The tree may appear to be in a perfectly healthy condition even with the entire inside rotted away, simply because the vital parts (three or four inches on the outside) are the last to be destroyed. Decay attacks and disintegrates the dormant tissues first, and gradually works outward. Cement in trees fulfills the three-fold purpose of stopping decay, serving as a structural support, and providing a surface over which the bark may heal.

Is cement work in trees a success? In other words, is tree surgery a real or fancied good? Does it save the trees? That depends on the vitality of the tree, and the ability of the man who undertakes the work. A man may be so nearly exhausted and so low in vitality that all the doctors in the land could not save him. A tree may be the same. If it is weak and far spent the chances are against it. If it is vigorous and healthy, the chances are all in its favor *if the man who operates knows how.* The only real test of a tree's vitality is the appearance and density of the foliage. A rich-green abundant foliage indicates health, and *vice versa.* And still almost the entire inside may have rotted away!

Tree surgery, or that part of it pertaining to the filling of cavities, is aptly comparable with dentistry. The three fundamental principles of each are the same. The dentist must remove all decay and prevent more, prepare the cavity so that the filling will stay permanently in place, and exclude all foreign substances. The tree surgeon must do the same things, although the means to that end may differ somewhat. To remove the decay from a cavity requires chisels and gouges of various lengths and sizes. The smaller cavities are not exceedingly difficult, although they require the same exacting care. The larger a cavity becomes the harder the task of removing the decay. It must be followed in the cracks and crevices and away up and down through limbs and trunk as far as it goes. It is sometimes burned out, although this measure is very dangerous unless applied by a man who thoroughly understands its use. When the decay is removed, it is wise to apply corrosive sublimate or a similar solution to destroy any remaining fungi. The walls of the cavity must then be thoroughly waterproofed to protect the wood. The waterproofing material must be durable, penetrating and adhesive. This is the first step and is very similar to the first principle applied by the dentist.

Perhaps the most difficult and trying part is in preparing the cavity so that the filling will stay permanently in place. This requires more than a knowledge of cement and its use. It requires more than a scientific knowledge of trees. It requires both these and more. The operator absolutely must know the practical methods of tree surgery, and have acquired almost instinctive skill with his hands by long practice. Cement improperly put into a tree is far worse than none. The law does not permit untrained men to practice upon the human body or even that small part of it called the teeth. Why should untrained men operate on trees which are just as much alive as human beings?

The cavity must be thoroughly braced if it has any size. No man can set down in words the manner in which this should be done, because it depends absolutely upon the size, shape and general condition of the cavity and the strength of the woody shell. The operator must determine the weakest side or point and brace it with great care. He must know what stress must be borne by the tree and insert steel ribs or truss rods to reinforce the trunk. All this must be done with a full appreciation of the fact that there will be *some* sway to the tree. Often-

times it is necessary to put the cement in in sections, leaving natural joints which will permit the swaying without damage to the cement fillings. If the operator does not understand the swaying of the tree and guard against it, or does not where necessary build his cement in sections, all his carefully laid plans up to this point will go for naught. Unless he can keep his filling permanently in place, just as in dentistry, his work is a complete failure.

The exclusion of foreign substances, especially water, is the ultra-important task of the tree surgeon, just as it is with the dentist. If the water seeps in behind the cement filling, it is only a question of time until the condition of the tree is worse than formerly. *No cement work is a success which does not exclude the moisture.* The skilled tree surgeon prepares a "water shed" at the edge of the cavity, beyond which the moisture cannot penetrate. To make assurance doubly sure he applies to this water shed all around the edge of the opening an adhesive waterproofing material. At times it is necessary to go farther than this and cover the entire opening with a metallic shield, non-corrosive, which is nailed very tight on the top and along the sides especially. Waterproofing material is then applied on the outside.

All of this must be done with the ultimate purpose of allowing the bark to heal over the filling. Therefore the filling must be *under the edge* of the bark at every point, and the contour of the tree must be restored, so that when the bark does heal over and seal the filling permanently, there will be no evidence of the old yawning cavity save the unobtrusive scar. As surely as there is health and vigor in a tree the bark will begin to roll out and over the filling. Nature responds wonderfully to proper treatment.

A tree is a living creature! This is the foundation fact of tree surgery. It ministers to the human family in comfort, health, beauty and pleasure. It is past valuation. It makes possible the solemn stillness of the forest. It holds in check the waters that go to form the rivers and insures their continuity. It robes the hills in green and hides their gaunt and lifeless forms. It gives grace and beauty and verdant loveliness to the valleys. It shades the urban highways where masses of mankind pass to and fro. It shelters and makes beautiful the public parks, the breathing places of the people. Its contribution to the food of man is of untold measure.

A tree is a fitting companion to man. It is quite proper that the highest development of the vegetable kingdom should contribute so largely to the well-being of man. Man should in turn give it reasonable care and protection so that its period of ministration may be a maximum. Because a tree is a living organism it is subject to decay and premature death. Tree surgery is the concrete expression of man's desire to protect the physical well-being of the trees and preserve them for his own pleasure and profit, and for that of the generations to come. Real tree surgery saves trees. It is well. Thus we have another step in the advancement of man.

M. L. Davey,
Scientific American, March 18, 1911.

For Particular Diseases. See under the *Various Fruits*.

Districts. See *Fruits Recommended for Cultivation*, under *Apple*, page 192.

Drainage

The greatest problem of an arid country is irrigation, and the next greatest is drainage, because in irrigation there must be seepage and waste that will injure and render more or less valueless the lower lands onto which this seepage and waste are drained. Very often it causes alkali deposits; or it becomes boggy so that few crops can be grown upon it.

Reasons for Drainage

First—It prevents water which falls upon the ground from remaining at or near the surface and renders the soil dry enough to be worked or plowed very soon after a rain, whereas if it is not drained, the farmer must wait for the water to seep away or to evaporate, and thereby lose much valuable time.

Second—It renders the soil porous and spongy, which enables it to take in the water easily.

Third—It prevents the adhesion or cementing of the soil, assists in pulverizing it, and allows the roots of trees or vegetables to pass easily through it.

Fourth—It assists in the mixture of the chemicals from manure through the pulverized portions of the soil, thus greatly increasing the amount of plant food available.

Fifth—It allows water which falls on the surface to pass down into the soil, carrying with it fertilizing substances.

Sixth—The temperature of the water of falling rain is generally much warmer than the subsoil of the earth, as is proven by the fact that the water drained from the subsoils is colder than the falling rain. A proper drainage system, therefore, will enable this warmer water to penetrate the earth and warm the roots of vegetables or trees, thus stimulating their growth.

Seventh—The increased porosity of the soil renders it a more perfect non-conductor of heat, and therefore the roots are kept warmer and the trees less injured by freezing in winter.

Eighth—It assists in aerating the soil, therefore aiding in the decomposition of any vegetable or organic matter in the soil.

Ninth—Farming operations may be begun earlier on account of the earlier drying of the soil in the springtime and an increase of crops is almost sure.

Tenth—It economizes labor by allowing work to go on at almost any time without waiting for the ground to become dried out after a rain and before plowing is begun. I have seen farmers with adjoining lands, one with his farm properly drained and the other not drained, and have seen the farmer with his land drained, plowing and cultivating, economizing the time and labor of men employed to work on the farm, the labor of teams, etc.; while the one by his side, with conditions almost identical, except that his land was not drained, with his hired men and teams lying idle, waiting for the ground to dry so that he could plow and cultivate.

Soil Conditions Where Drainage Is Desirable

It is better to drain where the water stands on the surface and interferes with the growing crops; where the water accumulates beneath the surface and originates springs; where there is a substratum of hardpan or hard soil that will not allow the water to pass through, but compels it to seep along on a hard surface called a water line; where they are basins or ponds that hold the water. Generally these basins are very rich in humus and under proper conditions would produce abundant crops. It is better to drain where the water flows from high lands that are being irrigated and where waters seep from higher lands. No matter whether these higher lands are irrigated or unirrigated, if there is seepage above, they should be drained. Drains are made of tile or burned clay, of concrete, or stone, or of boards, depending on the character of the soil and the choice of the one who does the draining. They are generally placed at such a distance apart as to carry off the waste and seepage water, and if the object is to open up and make pórous a compact soil, they are generally placed about 2½ to 3 feet deep and 25 to 30 feet apart.

The problems of drainage in the volcanic ash soils of the Northwest are vastly different from those in the open, porous and sandy soils of some other sections of the country. This grows out of the fact that the volcanic ash soils incline to pack and puddle when the water is placed upon them and are not so susceptible to the influence of drainage systems, as are most other soils.

GRANVILLE LOWTHER

History and Principles

The primary object of drainage is to decrease the excessive supply of soil water, while in irrigation the chief object is to increase the amount of soil moisture. In either case we are dealing with moisture, and a knowledge of its forms, movements and control is of great importance at the beginning.

Importance of Soil Moisture

Of all the factors which influence growth, moisture is without doubt the most important. Plants suffer more frequently for want of proper moisture conditions than they do for want of chemical elements of plant food. Moisture is a carrier of plant food on the soil and in the plant. There is a wide range in which the moisture content will be favorable to growth, but for each soil there is a low limit at which plants wilt for want of moisture, and there is also a line of excessive wetness above which nothing but water plants will thrive. Moisture is necessary to bacteria of the soil. It gives turgidity to the plant cells and makes plant food available.

Supply

The amount of water in the soil is not always greater in the region of greater rainfall. Soil of a wet climate may dry and bake quickly after rains. The initial amount of water will depend on the rainfall, and stored supply as for irrigation. A thing that is more important is the supply during the growing season, so the amount of rainfall is not so vital as the time of occurrence. The rate of loss and the retentive capacity of the soil will modify the amount available during the growing season.

Forms

1. Hydrostatic water. This can be seen and is free to move by gravity. It is removed in drains. 2. Capillary moisture. This is held against the force of gravity by surface tension. It is the form used by plants. There is no distinct line between this and free water. 3. Hydroscopic moisture This is absorbed by dry soil from the air.

Limitations

The maximum amount of the different kinds of soil moisture depends on texture, structure and content of organic matter.

Movements

Percolation. This is more rapid in tile after small streamlets have formed in the soil about the tile, and in coarse grain soils. Run-off may remove a large percentage of the rain. Evaporation. Most of the rain not lost by percolation is lost by evaporation. Capillarity. Relieves congested condition at the surface when water first comes to the soil. Capillarity depends on gravity, surface tension and pressures.

Control of Capillarity—Increase by Irrigation—Decrease by Drainage

We will for the present omit the methods for increasing the moisture content of the soil, and take up the methods of decreasing the water content. The three ways of doing this are:

1. *Cultivation.* We can hasten evaporation by early spring cultivation of the soil. By increasing the air circulation and leaving the soil with an uneven, rigid surface which exposes a greater surface for evaporation. Rolling a light sandy soil causes upward capillarity and increases evaporation at the surface. When rain falls on the soil it can be lost by run-off. Cultivation will check excessive run-off It will also increase the water capacity and there will be less percolation.

2. *Growth of Plants.* Crops of any sort, weeds and cover crops will dry the soil by transpiration of the water through the leaves. This may be taken advantage of in taking out the excess water in the early spring. We can take advantage of this in the fall, when the cover crop is planted in the orchard to take up the moisture and check the growth, so the buds will prepare for winter.

3. *Drainage.* Drainage consists essentially in the direct removal of gravitational water from the root zone of the soil by affording free passages for its percolation and flow. This is the chief means of decreasing the supply.

History of Drainage

The subject of drainage is attracting more widespread attention throughout the country at the present time than ever before. It becomes more important as the agricultural resources of a country are developed. There are over 1,000,000 square miles in the United States that must be drained before they can be utilized. Thirteen per cent of the irrigated

lands of the West are already injured by alkali and are in need of drainage.

The history of drainage shows that various methods and materials have been used in the past, but we have now settled on one universal method. The first record of tile drainage is found in the garden of a monastery in France about 1620, where it was noticed that it was very fertile in times of drought, and that the quality and earliness of the fruit were very marked. Investigation revealed that tile 10 inches long and 4 inches in diameter were in the soil in such a manner as to form a drain at a depth of 4 feet. Each pipe was funnel shaped and made to fit into the next one. How early they were placed there was not known.

In 1650 Captain Walter Raleigh published a book on drainage called "The English Improved Agriculture," in which he proposed a plan of boring down into the hard sub-strata and letting the water down into the gravelly zone underneath. In 1832 the Denston system was introduced by Mr. Smith of Denston, Scotland. This was a system of clay pipes. In 1833 Smith published a pamphlet entitled "Smith's Remarks on Thorough Drainage." His plan was as follows: 1. Frequent drains. 2. Shallow depth, some 30 inches. 3. Parallel drains at equal distances apart throughout the field. 4. Minor drains should run down the steeper places and the main drains run along the chief hollow, tributary drains being provided for lesser hollows.

In 1837 Mr. Johnson, of Geneva, N. Y. introduced tile drainage on his farm. This was the first drainage system in America and is in still successful operation. Drainage has been rapidly developed in the Middle West during the last 20 years. Drainage laws and drainage machinery have helped to reclaim swampy areas in the Central states.

Box, stone and brush drains have given place to tile drains, which are now in general use. There are over 5,000 tile factories in the United States; some are very large. To make tile requires expensive machinery.

Soils That Need Drainage

Soil texture and structure. These often determine the need of drainage. Clay offers great friction to the movement of water. It has a greater water capacity and is apt to have a compact puddled structure. In retentive soils the first step in improvement is drainage. Getting out the excess of moisture assists in granulation. The addition of fertilizer will only be effective after good drainage. The order of improvement should be: 1. Drainage. 2. Tillage. 3. Manure. 4. Lime.

Soil and Subsoil

Soil is the surface strata where the bulk of plant foods are found, while subsoil is the strata on which the soil rests. It is lighter in color, finer in texture and contains less organic matter. Certain proportions of gravel and clay form hardpan. Iron or lime may cement and clay and give the condition known as hardpan.

Water Zones

There are three zones of flow of water through the soil: 1. The saturated zone or the strata through the water moves vertically to the water table. It may move by capillarity or by percolation or both. 2. Surface zone. This is the water table. In winter the water table is very near the surface, and in the summer the water table goes down to various depths, sometimes quite deep. 3. Deeper zone. Veins of water.

All soils must be drained, but fortunately most soils are more or less drained naturally. Natural drainage is much cheaper. The following are the conditions which require drainage:

1. Nearly flat lands upon which the water from the surrounding higher lands collects.

2. Areas adjacent to higher lands where the soil is of such a nature that water which falls on the upland will seep under and out through the low land, making it wet.

3. Lands inundated regularly by the rise of tides or frequently by the overflow of rivers.

4. Extremely flat lands in wide areas which are underlaid near the surface by

a thick, close, nearly impervious clay subsoil.

5. Lands like rice lands, water meadows and cranberry marshes, where water is applied excessively and must be removed again.

In general, all low-lying fine-grained soils with fine, heavy subsoil will need drainage.

Benefits of Drainage

1. Removes excessive water. 2. Increases the capillary supply of moisture. 3. Improves the texture. 4. Increases the root pasturage. 5. Affords better air circulation. 6. Makes the soil warmer. 7 Lengthens the growing season; firms the soil. 8. Assists decay and nitrification. 9. Prevents erosion. 10. Diminishes the effect of drought. 11. Prevents heaving. 12. Prevents the rise of alkali. Drainage does this and more. It pays in increased yields and land values. Road drainage aids in transportation. Sanitary drainage improves healthfulness. To what extent drainage is warranted depends on the crops to be grown.

Kinds of Drainage

1. Natural drainage. (a) Through gravel subsoil (b) Through surface run-off.

2. Artificial. (a) Open drains. (b) Underdrains (brush, stone, box for alkali and tile).

The object of underdrains is to assist the action of gravity. Both surface and underdrains have their field for usefulness.

A. Open drains or surface drains are essential auxiliaries to tile for drainage of large areas. They remove water from the surface and also from the subsoil. The amount removed from the subsoil depends upon their depth and fall and the amount of water in the channel. Surface they are adapted to: 1. Where the volume to be removed is large. 2. Where the water table is near the surface. 3. Where the drainage is designed to be only for a short time. 4. As a supplement to tile drainage for large areas of flat land.

The efficiency of open drains depends on the surface flow of water into the channel. A double plow should be used to make dead furrows that will serve as surface drains and as temporary storage for excessive water. In order to drain the subsoil the ditch must be deep enough to permit percolation from the adjacent subsoil and the efficiency will depend on the texture and structure of the subsoil

To be effective, an open drain must be evenly graded and have a smooth bottom and sides, and these side walls must be staple. A semi-circular form will give the greatest carrying capacity per cross-sectional area, and will have the least surface friction. Usually the bottom will be made flat, however, and will be about one-half the width of the top. The slope of the wall will vary with the soil. One to one slope is commonly used with clay, and one and a half to one for loam soils. Lighter soils will stand a deeper grade. The fall should be uniform and just sufficient to afford scouring without erosion or silting. Silt or sand is more susceptible to erosion than clay. Sedimentation will be less where growth of vegetation in the bottom is prevented.

When it is desired to reclaim and improve large areas of level land such tracts must be cut up into sections or districts by large open ditches, in order that tile drains may be laid in every part without necessitating the use of mains too large and costly to be profitable. While these open ditches are not desirable in themselves, since they occupy the land and divide the field into irregular shapes, yet they are necessary to every large system of drainage. They should be located with care, following the course of natural drainage as far as possible, with due regard to straight courses.

Construction of Ditches

A common method of making small open ditches is to use a team and scraper. This is a good method to use where the earth is dry enough to afford a footing. Contractors have done such work for as low as ten cents per cubic yard, where conditions were favorable. A large part of the open ditch work must be done in swamps, and where it is too wet to use a team and scraper.

For the construction of small and shal-

low ditches, what is known as the capstan ditch plow is used in some localities. This is an immense plow which makes a ditch by cutting and throwing the earth from the center each way, its action being similar to a common sod plow. There are wings which push the loose earth three feet away from the edge of the ditch, leaving it in a large continuous ridge on each side. The plow is pulled by two capstans, each of which is turned by a team of horses. The capstans are anchored ahead, and their winding drums are attached to the plow by winding ropes. This machine makes a clean ditch 8 feet wide at the top, 1 foot wide at the bottom, and ordinarily limited in depth to 2½ feet. Used in Minnesota. Contract work is taken for about $1 per rod of completed ditch. The earth should be wet for this plow to work easily.

Steam dredges are used for the reclamation of large areas, and are of three different types. 1. Floating dredge; begins work at the upper end of the channel and works towards the outlet. There must be sufficient water in the ditch to float the boat which carries the engine and excavating machinery.

The excavated earth is deposited on each side of the ditch about 9 feet from the edge of the channel. This style of dredge is adapted to the excavation of large channels, varying from 12 to 40 feet wide, and as deep as required. It has been used extensively in the Middle West. The ditch has a shape similar to the letter U.

A second type of steam dredge will make ditches 4 feet at the bottom, 12 to 15 feet at the top, with a depth of from 4 to 9 feet and a slope of 45 degrees. This machine is placed at the outlet and pulled up grade by means of a drum and cable. No water is required in the ditch in order to operate it. It is limited in its field and not much in favor with contractors.

The third type of steam machine has similar limitations. It is constructed to move up grade on the surface of the ground in advance of the excavation. The plant carrying the machinery rests upon long runners which rest upon movable rollers. The plant is moved by a cable, one end of which is attached to a winding drum at the engine, and the other to a log anchored some distance ahead of the machine, technically called a "dead man." The excavating machinery consists of two dippers which are filled by being pulled toward the machine and then dumped alternately.

The machines described have been used for 15 to 20 years. The boats are built and the machinery mounted where the work is to be done. The machines cost not less than $5,000 each. They are operated by contractors, who provide themselves with full equipment to do the work by the cubic yard, under direction of an engineer. Contracts have been taken at 6 to 15 cents per cubic yard. The larger contracts approach the lower figure. Large areas are drained co-operatively, each farmer benefited paying a share. In most states the main canal is subject to the drainage law.

The course of ditches and streams is crooked in flat land, but artificial drainage channels may improve and straighten them. Ditches on rolling land may differ from those on flat lands by having narrow bottoms, since the velocity of flow is sufficient to scour and deepen them. The outlets of tile in rolling land may be shallower where there is a marked rise in the ground surface above the outlet.

Cross-Section and Behavior of Ditches

It has been found by experience that ditches may be constructed with sides more nearly vertical than was formerly thought practicable In stiff loams and clays it is not desirable to cut sides with slopes greater than 1-1. Loams, 1½-1. Ditches made with a floating dredge have a slope of about 1½-1. Weathering and erosion will in any case change the slope, so it is of greater importance to secure ample bottom width in order to allow this change than to attempt to make the exact slope desired and to expect it to remain.

The excavated earth, or waste bank,

which lies in unsightly masses along the edge of the ditch will, in a year or so, assume a more workable shape and can be leveled down with the plow and scraper, until the land can be cultivated nearly to the edge of the ditch. It is always well, however, to keep a strip on each side bordering the ditch in grass, to prevent crumbling of the banks and loss of soil from the adjoining field. The space between the waste bank and the ditch is called the borm, and should equal the depth of the ditch. Water will flow with a fall of six inches to the mile, but to be effective the fall of a ditch should be from 4 to 6 feet. Large and deep ditches made straight and so constructed that they will not receive silt or debris in large quantities will probably be self-cleaning, are necessary for large areas, and should be from 6 to 10 feet deep.

In many cases the entire grade for lateral drainage must be made by additional depth of the outlet. The velocity and carrying capacity of the ditch increases with the depth. Water eight feet deep will have twice the velocity of that one foot deep for the same width of ditch. This partly explains why shallow ditches make poor drainage outlets.

Capacity

The capacity depends on the area to be drained, the slope of land and the fall obtainable. See text for tables.

Velocity of Discharge

This is modified by the fall and a number of other factors. A poor ditch with a rough bottom and irregular sides will carry only about half as much as a smooth, cement-lined canal. Grass and weeds will decrease the capacity to about one-fourth. The form of ditch is very important.

Wetted Perimeter

The sides and bottoms of the ditch touched by the water are known as the wetted perimeter. Friction varies directly with this factor. The wetted perimeter should be as small as possible in comparison with the cross section.

Disadvantages

Open surface drains have several disadvantages as deep soil drains.

1. They are seldom of sufficient depth.
2. They are apt to have a small carrying capacity, due to their uneven grade and rough bottom and sides.
3. They are expensive to maintain.
4. They waste much land.
5. They greatly interfere with cultural operations.
6. They may be subject to serious erosion.

Covered or Underdrainage

This is the only complete form of drainage. Underdrains or any underground channels are constructed for the removal of water. Many kinds of materials have been used for this purpose, but in recent years they have been almost entirely supplanted by tile. Brush, stones, boards and bricks were formerly used. Underdrainage will improve the soil wherever there is not complete natural drainage.

Tile

Tile is best for underdrainage because it is the cheapest, the most durable, the easiest to lay, and finally because it will drain the soil most quickly. Box drains will last from ten to twelve years. In draining the land with red tile use well burnt cylindrical tile. These tiles, one to two feet long, are laid through the soil in one continuous line with such a grade that all water which finds its way into them will be carried by gravity to the lower end of the line, thus carrying the surplus away. The water enters the openings at the ends, or joints as they are called. The ends of the tile are placed close together in order to prevent the soil from entering, yet none too close to prevent the water from entering The action of the tile drain in removing the surplus water from the soil is as follows:

The drain being surrounded with soil, the spaces of which are filled with water, the water in the soil flows by gravity through the crevices in the ends of the tile and passes off more or less rapidly, according to the grade with which the tile is laid. Other water of the soil

takes the place of that removed by percolation. Water moves downward and laterally toward the drain, and the lateral distance through which the drain will relieve the soil of water is governed by the resistance which the soil particles offer to the flow of water among them. This process does not leave the soil without moisture, but simply removes the excess or free water and makes more room for the storage of capillary or usable water. It does not remove the free water from points below the level of the drain. The free water removed by tile drains may come from rain, or it may come from seepage.

Kinds of Tile

1. Red tile.
2. Vitrified.
3. Cement—except the very large ones—is more expensive than the red clay tile. It becomes harder as it ages, and is more durable.

The tile should be round in form, straight, and every particle of clay used in making them should be completely burned. Such a tile will last indefinitely in earth and water. Where exposed to long-continued freezing and thawing, as at the outlet, the best vitrified tile should be used. After one has become familiar with the product of a given factory, properly burned tiles may be readily distinguished by their color and by their ring when struck with a piece of steel. Good clay may be semi-vitrified by skilful burning. Porosity of the finished tile is not important, since the per cent of water that passes through the walls of the tile is very small. Vitrification is desirable.

Systems of Drainage

Mains, sub-mains, laterals.

Single, double, natural, grouping, gridiron, parallel.

The natural and grouping systems are used where the aim is not to secure perfect drainage, but rather so nearly sufficient for ordinary crops as to make the increase in yield pay a fair return for the money invested. They can be used to remove water that has collected in low places.

Compare the amount of double draining with the gridiron system and parallel system. The latter has the advantage here, but long parallel lines will require large tile, or else many junctions. The parallel system is generally the best.

Depth, Frequency and Size of Tile

Principles of Drainage—In general we should drain the land where the water collects.

1. Lay the mains in the line of natural drainage, except where a "cut-off" will be in line of economy.
2. Lay the laterals in the line of greatest slope, otherwise the water may ooze out of the tile in the upper part of its course.
3. Use long parallel laterals in place of short ones where possible.
4. Make the lines straight and with easy curves—easy to lay.
5. Bring all the land needing drainage under the influence of the drains.
6. Use the level wherever in doubt.

In addition to this, keep the water spread out. Small tile are cheaper.

Depth, Frequency and Size of Tile—These three factors are closely related and constitute the most important part of drainage. These factors will depend on—

1. The character of the soil and subsoil.
2. The amount and distribution of rainfall.
3. The topography of the surface.
4. The crop to be grown.
5. Prevalence of underground water.
6. Level of the ground water.

The system should always be arranged with reference to these conditions.

Depth

The depth must be such that water can get to the tile before it shall have caused serious injury to the crop. The drain should be near the water to be removed, and below the bulk of the roots. This necessitates that it be shallower in clay to work properly. In coarse texture soils the drains attain their full efficiency almost at once, but in dense clay there is an increasing efficiency as the soil becomes granulated and the system is estab-

lished. Some silt is washed out through the tile, and tiny streamlets are formed leading to the joints of the tile. A dense clay holds its pores almost full of capillary water, which is not subject to percolation. With this condition the drain must be near the surface and function chiefly as a surface drain. Deeper drains are necessary in orchards, irrigated fields and all deep rooting crops. In general it is not desirable to lower the water table as far in sand as in clay, because there is less capillary action in the former. Place tile on the boundary of sand and clay if this is from two to four feet below the surface. This allows the water to move to the tile through the sand. Generally three to five feet will be sufficient depth, and three and one-half is the common depth The rule in the reclamation service in draining alkali land is to never place the tile more than four feet below the surface.

Frequency or Distance Apart

The distance apart is closely related to the depth. It also depends on the texture of the soil and the amount and rate of the removal of rains.

1. *Relation of Depth and Distance Apart*—If tile placed three feet deep and 100 feet apart lowers the water table one foot from the surface at the highest point, then placing tile four feet deep will lower the water half-way between them, two feet below the surface. We could accomplish the same thing by placing the tile 50 feet apart and three feet deep. If we put the tile deeper it will draw the water further each way, and the tile can be laid less frequently.

2. *The Amount of Rain and the Time Allowed for Removing It.*—Water moves through clay very slowly, and if a large amount is to be removed in a short time the drains will necessarily be placed close to the surface, and at frequent intervals their function will be primarily as surface drains.

3. *Influence of Soil Texture.*—In clay the interval must be much less than in sand King found that 48 hours after a heavy rain the water table was one foot higher in clay soils at a distance of 27 feet from the drain. In sand the grade was one foot in 175 feet. Then to remove the water table to within one foot of the drains in clay, the tile lines would be placed every 54 feet, while in sand the distance would be 350 feet. This is probably the extreme, and the tile would need to be larger with this greater distance. Impermeable soil will require frequent parallel drains where level. Use the regular, thorough system of drains where level, uniform soil is to be drained. The aim should be to reduce the water table a definite distance in a reasonable time after rains, and the drains must be sufficiently frequent to accomplish this.

The natural system removes water where it has accumulated in low places. Large areas are drained by single lines of tile. The tile follows the natural water course, or is placed so as to intercept the seepage. This will do where the aim is to secure only fairly perfect drainage, so nearly sufficient for ordinary crops that the increased returns will pay a fair return for the outlay.

Where in doubt, one could adopt the minimum interval and place the first line of tile at two or three times this interval If necessary, other lines could be placed between these at a later date.

Experience with different soil conditions has given us a fairly definite distance for placing tile in given soils:

100 feet to 90 feet apart for sandy soils.
60 feet to 75 feet apart for loam soils.
50 feet to 60 feet apart for sandy loam.
40 feet to 50 feet apart for loam.
35 feet to 40 feet apart for heavy loam.
30 feet to 40 feet apart for heavy clay.
30 feet apart for soils high in iron and clay.

Size—The size of the tile depends on:

1. The amount of rain.
2. The rate of removal.
3. The amount of surface run-off.
4. The grade.
5. The soil.
6. The area drained.

There are times when the crop has taken the moisture out of the ground so that a two-inch rain will not start the tile. At other times it may be necessary

to remove a large part of the rain in 48 hours. At times the water cannot pass through the soil fast enough, even though the tiles are large enough to carry it off, so that part will need to be removed over the surface.

The total rainfall in different sections varies materially. Drainage has to deal with extremes of rainfall rather than the mean. Laboratory experiments are so different from field conditions that our best deductions come from the working of drains in land of a known character. Generally, if the main drains have the capacity to remove one-half inch in depth of water from the entire tract in 24 hours, they afford what may be regarded as good farm drainage. This is the capacity of many good systems in alluvial soils. In places where no advantages can be taken of surface flow, mains may be arranged to carry away one inch of water in 24 hours.

Where several laterals empty into a main, the latter must have a capacity nearly equal to their combined flow; but it is not possible to calculate the total or relative sizes with the exactness which is possible with a pressure system of pipes. This is due to the effect of the soil, which acts as a sponge, and gives up its water gradually and to the eddies caused by joints. The greater the fall the greater the capacity.

The area of a cross-section of a tile increases in ratio of the squares of the diameters. Thus 2, 3, 4 and 5 feet tile have cross-sectional areas with a ratio of 4, 9, 16 and 25 square inches. Friction and eddies are less in large tile, so that doubling the size of tile makes the capacity more than four times as great. Longer length of tile gives less capacity, due to increased friction. In general, a 4-inch tile will drain about five acres, and should not be over 500 or 600 feet long. A 5-inch tile will drain 10 acres; 6-inch, 20 acres; 7-inch, 40 acres; 8-inch, 60 acres.

Direct Leveling

The first working principle in drainage is the finding of the differences in level of two or more points.

A level surface is one that is parallel to the surface of standing water. A water surface is not level theoretically, due to the curvature of the earth's surface. It is assumed to be level, and perpendicular to a vertical line or the line of gravity. Thus a true level line is a curved line whose points are all equidistance from the earth's center, and is apparently level.

A point is above or below another point according as it is a greater or less distance from the earth's center. This difference is called "difference of level" of two points. The height of a point is its distance above a given surface, measured on a vertical line, and is called its elevation.

Direct leveling depends on three principles:

1. That the surface of a liquid in repose is level.
2. That a vertical line is perpendicular to that surface.
3. A bubble of air confined in a vessel otherwise filled with liquid will rise to the highest point in that liquid.

In direct leveling two instruments are necessary. (1) The "Y" level, which is an instrument that can be adjusted so as to mark out a horizontal place in any direction from a given point. (2) A leveling rod, an instrument that can be used to measure vertical distances. As accessories to the work, we need a tape line, or chain, for measuring distances, and a set of eleven pins for marking points; also some flags.

Definitions

A datum line is the base line to which the elevation of every point of a series is referred.

Benchmarks are permanent objects whose elevations are determined and recorded for future reference.

Turning points are points where the bearing of the line changes, and these are marked by placing a pin in the hub stake used at this point.

Backsights are readings on points whose elevations are known. A backsight is taken for the purpose of obtaining a new height of instrument. Backsights are plus quantities and are to be added.

Foresights are readings on stations whose elevation is to be found. Foresights are minus quantities and are to be subtracted from the height of the sight line. This gives the elevation of the station road.

Laying Out a Drainage System—Records

The first thing in laying out a drainage system is to tramp over the land to be drained and find out the lay of the land and then set up some flagpoles. Just a straight stick with a cloth on top will do, if you do not have regular surveyor's poles. These are placed so that the chainman can chain the levels.

A Preliminary Survey

It may be exact or it may be taken roughly. It may be necessary to make a topographic map of the whole area to be drained. In this sort of a map put in streams, etc. After this you should decide on some definite plan. Decide on some bench mark. Then go ahead and take your level notes from which you could figure your total available fall. Should chain all the lengths in order to know accurately how much tile you will need. Then make a statement and put down how many 8-inch, 6-inch, 4-inch and 3-inch and then total up and see how much it will cost.

Contour Maps, Relief Maps

A contour line is simply a line connecting all points of equal elevation. To make a contour map take the elevation of every certain distance, say 100 feet. This distance is regulated by the topography of the land to be drained. Sometimes make a topographical map and then below make a relief map. Every farm subject to drainage or irrigation needs to be provided with a contour map. Such a map will show the proper location of drains or irrigation ditches.

Profile Maps

These show a cross section of the strata through which the line of tile is to pass They will show you the depth to be dug at each station. In preparing profile maps use a scale of four feet to the inch vertically, and 100 feet to the inch horizontally. The tile line should be in red ink.

Permanent Map

Plane table. The permanent map should be accurate so that in after-years it would be possible to go out in the field and locate the drainage system or any part of it immediately.

Details of Drainage

The bearing of the line is the angle which it makes with the magnetic needle.

Length of Laterals

This should not exceed 800 or 1,000 feet for 3-inch tile and may be 2,500 feet for 6-inch tile.

Amount of Fall

Fall is the common term for slope of land or for total head when applied to drains.

Available fall is the fall that can be given to a drain in a prescribed distance, and may be greater than the fall of the surface.

Grade of a drain is the rate of fall expressed in decimals of one foot per 100 feet. A uniform grade is simplest, but it is often necessary to change the grade. When this is done it is best to change from a less to a greater grade. A change from a greater to a less fall would check the velocity and cause silting of the drain. If it is necessary to change the grade, it is a good plan to use a silt basin.

Silt Basins

Silt basins are small cisterns in the drain extending to the surface and affording a means of cleaning out the silt. They help to collect flood water quickly. They prevent the drain from being clogged and becoming silty. They may afford watering places for stock. In a small drain a large 12-inch tile may be used by standing on end. Larger basins may be used made of brick, or boxed up with wood, and should be three feet in diameter, so that a man can enter and clean out the silt.

Collars

The use of collars is obsolete. Gravel or straw may be used in heavy soils where convenient, to allow water to enter tile more readily. The big problem in clay

land is to get the water into the tile, as it does not draw well, so sometimes gravel is put in. This will help for several years, but in a volcanic ash soil or in heavy soils it will become silty.

Junctions

Laterals should enter the main at an angle of 45 degrees, and with a slight fall. It is then less likely to clog up, and is not so likely to back up and become silty. Sometimes the drop will only be one-tenth of a foot, sometimes more.

Sinks

They are useful in ponds where there is a layer of hard clay underlaid with sand. They are made by simply digging a small well (probably three feet in diameter and 12 feet deep) down through the clay to the sand to let the water through. Sometimes this is all the drainage that is necessary.

Surface Vents

They may be on the order of silt basins or catch basins. Surface vents are used to catch surface water. Surface vents are also used to afford ventilation in close soils.

Outlets

Outlets are very important. It is necessary to have a good outlet. Where the outlet is submerged and the velocity of the outflow is checked, sediment is apt to collect and clog the drain The water should have a free spillway at the outlet. Vitrified tile, wood or masonry should be used at the outlet where the drain is exposed to frost.

Obstructions

The principal obstructions to tile are: 1, Small animals. 2, Roots. 3, Silt. The outlets should be protected with screens to keep out small animals. A good screen is made by a ¼-inch iron rod set one inch apart. The roots of such trees as willow, elm, larch, tamarack and soft maple are troublesome. Also alfalfa and grapevine roots. Trees within 15 or 20 feet of the drain should be girdled or cut down. Silt will be less troublesome in large tile. Small tile must be laid true to grade to prevent trouble. To locate obstructions dig holes in several places over the tile. When below the obstruction we find the water will fall away into the tile, above the obstruction it will stand in the hole.

Digging, Laying to Grade and Covering Ditching Tools—Their Uses

Tile spading for removing the first spading is 18 inches long, concave, with a square cutting end. It is important that the ditch be started properly, so that the sides are plumb and smooth. The beginner makes harder work and less progress by cutting the spadeful too thick. Cut one inch and dovetail at center. A three-foot ditch should be started about nine inches wide. The common round-pointed shovel may be used to remove crumbs from the bottom of first spading. Leave crumbs till last in dry weather. The second spading is removed by use of a spade about 16 inches or less in length, concave with rounded cutting edge. The second spading should go to within one inch of the grade line. Crumbers are used to remove crumbs from the last spading and bring the ditch to grade. They are concave, semi-cylindrical, with rounded cutting blade at either end. The handle may be set at any angle. Can get 3-inch or 6-inch size. Man with crumber should keep near the one who is laying the tile.

Tile Hooks

Tile hooks are used for smaller sizes of tile, and are a great aid to rapid work where the tiles are cylindrical and the ditch is carefully prepared. A good hook should be less than a right angle, and may be made by running a 10-inch bolt through the pole about two inches from the larger end. The pole should be a little larger than a rake handle, and the end may be used to tap the tile firmly into place

Laying to Grade

This may be done by use of a line, by use of targets, or by use of line and frequent cross lines.

Difficulties

Quicksand—caving in.

Laying Tile

In laying tile take advantage of imperfections in tile and make them fit the

joints tightly. Keep true to grade and in a straight line or use easy curves.

Covering

As soon as it is inspected, blind tile. The ditch may be filled with a plow, using long double tree where no crop is growing. Plow may be used to open ditch where it will not interfere with crops or surveyor's stakes.

Drainage of Farmyards, Buildings and Road—Septic Tank

Road Drainage

Drainage is the foundation of good road construction. The surface must be crowned. Use frequent culverts and passages to fields and avoid letting the water accumulate so that it has much erosive power. Use "water breaks" on hills to throw water to side of road. Keep the surface smooth and with a 1 to 20 slope to the exact peak of the road, not rounded. Side ditches should have flaring sides, 1 to 18 slope on side of hills. Protect the side of the ditch from erosion by paving the bottom with stone or brick.

Sub-Drainage

A good road must be thoroughly drained, and artificial drainage should be provided in low, wet places. Get rid of the water in the foundation of the road before frost. Three-inch tile with a fall of 3-10ths of a foot per 100 feet—cross drains.

Barnyards, Buildings, Etc.

There should be a ditch around the farmyard to shut out any water that might run in from the outside. Have the feed floor slope gradually to a catch basin and carry the water below. Water from caves should also be collected and carried to a catch basin. This basin should be large enough to check the water and allow the silt to settle. The inlet must be protected by wire grateing. Drain around all basements.

Septic Tank

Waste from farmhouse and from the other buildings can best be handled by means of a sanitary septic tank. A tank 3x5x6½ feet is large enough for a farm or for 10 or 11 persons.

The liquid as it passes out is free from disease germs, and it percolates away from tile to soil.

In close ground it may be well to put a load of gravel along in the trench before laying the tile. The capacity required per person is about four cubic feet. The tank need not be more than 20 feet from the house. Sewage contains about two parts per thousand solids. One of those two parts is mineral matter, the other organic matter. The mineral matter will not dissolve or decompose, and so a manhole is provided at the top for cleaning out about once a year. The liquid leaving the tank should be almost odorless, but in order for this to be so there must be no strong currents in the tank. The inlet should have but a moderate fall, one inch per rod. In cleaning out, do not remove the scum, as this contains the ferments, causing decomposition of the sewage.

Materials for the Septic Tank

Gravel, 2½ yards; sand, ½ cubic yard; cement, 3½ bbls.; lumber for form; tile at outlet, 50 feet; vitrified brick, 60; sewer tiles; labor.

The cost complete is $30 to $35.

Special Drainage Problems

Muck Lands

These lands part with their moisture easily and may become too dry. They settle when drained. Open ditches four feet deep and 200 feet apart, or tile drains 150 feet apart will in general be about right. Because those soils part with their moisture readily they may be drained very successfully. Frequently cranberry marshes will not need to be thoroughly drained, but drained part of the year.

Drains to Prevent Erosion

This is frequently a special problem. On hill sides use open ditches of moderate fall, or underground tile lines. Plow the ground so as to have terraces running around the mound and check the run-off.

Salt Marshes

These are problems that need special attention. To drain salt marshes dyke the tides out and then collect the water

in surface ditches. This will generally require an engineer. Select land that is close to a market. Should be governed by the location of the land, its nearness to market, as to whether it will pay to drain. Locate the dykes so that the drains will discharge at low-tide. These dykes should be high, strong and wide, and provided with tide gates. Then the drainage area should have main drain and laterals leading to it. The rains and drains should remove the excessive salt in a couple of years, during which time the land may be pastured. Sorghum or rye may be used for the first crop. Cost of draining such lands will be about $30 to $60.

River and Creek Bottoms

Straighten the stream, dyke the upper part of the flat lands necessary, clear the river channel of brush, deepen it if necessary, clear the land of organic matter where the dyke is to be built. The slope of the side walls will depend on the character of the soil. They ought to be three feet above the high-water mark. They are ordinarily six or eight feet wide on the top. Sluice gates are necessary so that you can let the water out when necessary.

Drainage of Irrigated Lands

About 13 per cent of all the irrigated land in the United States, or about one million acres, is in need of drainage. The reason for this is the excessive use of irrigated water. The first appearance of excessive water is the appearance of swails and swamps, and later on white and black alkali, brought to the surface. The water table rises, and when it reaches to within several feet of the surface the alkali or soluble salts rise to the surface, the water evaporates and leaves this deposit of salt. (See next article.)

Remedy

The best remedy is to drain the land. Lower the water table to about four or five feet below the surface. The seepage from above should be intercepted and removed by a deep cut-off ditch. Use a second ditch if necessary, and then tile below as needed. The size of the drain depends on the area above. It may be necessary to line the canal in places where the soil is gravelly.

Kind of Drain

It should be four to seven feet deep and may be open ditch. Box drains are often better than tile. Use the larger size, never less than five inches. Box drains should never be less than 6x6 inches, while 10x12 or 12x20 inches is often used. Tramp the dirt back into the trench and watch surface irrigation water to prevent it from entering the tile.

Obstructions are more frequent in irrigated land. Alfalfa roots have been cleaned out by dragging brush and wire through. Should leave a manhole to the tile every 500 feet.

Arid soils are not full of water crevices and water moves in special underground passages. In planning for a drainage system, the first thing is to study underground conditions and lay drains to the water.

Cost of Drainage

First of all, we must know the number and size of tile required before we can make any definite estimate.

Items of Expense

1. *No. of Tile*—Lay direct to source of water and use no more than is necessary.

2. *Cost of Tile*—3-inch, $16 per 1,000; 4-inch, $20 per 1,000; 5-inch, $30 per 1,000; 6-inch, $40 per 1,000; 8-inch, $60 per 1,000. (Of course, the price of tile will vary at times and in different localities. The prices given above are for the local market.)

3. *Freight if Shipped*—3-inch tile weighs 4½ lbs.; 6-inch tile weighs 11 lbs. The cost of freighting tile is about 10c per 100 lbs. This is for small quantities.

4. *Hauling and Distributing*—3-inch tile will run about 400 to the load, and 6-inch tile about 175 to the load. Cost about $5 per team.

5. *Digging and Laying*—$2.50 to $3.50. Considerable tile has been laid in this vicinity for 40-60c per rod. This includes filling the ditch.

6. *Laying out and superintending*, 5 per cent.

Tile required per acre if laid parallel and 50 feet apart will be 872 feet. Calculate the cost of such thorough drainage per acre of 4-inch tile.

Benefits

1. *Cause Firmness and Fineness of the Soil.*—The excess of water recedes from the surface and takes its place lower in the soil, soon leaving a firm surface, which can be passed over by teams or live stock without injuring the texture. The fineness of the soil is increased by percolation.

2. *Permits Earlier and More Timely Cultivation.*—The water from rains and thawing ice passes down through the soil, admitting warm air and rains, so that the surface is ready for early plants much sooner than wet soils.

3. *Produces Aeration of Soil.*—The interspaces of soil becoming relieved of water are filled with air which carries fertilizing gases and furnishes oxygen to the roots of the plants and for the support of soil bacteria.

4. *Increases the Temperature of the Soil.*—This is explained in King's book on "The Soil." If we allow the surplus water to drain away from the field rapidly, rather than to hold it there until it has time to evaporate, it will greatly favor the warming of the soil.

5. Prevents a large waste of fertility by surface washing.

6. Increases the depth of the soil.

Approximate Prices and Weights of Tile

Size in inches	Price per 1,000 feet	Weight per foot in pounds	Average car-load in feet	No. of feet per ton
3	$ 16	4½	7,500	400
4	20	6½	6,500	334
5	30	9	5,000	250
6	40	11½	4,000	182
7	50	14	3,000	143
8	60	18	2,400	111
10	90	25	1,600	80
12	120	33	1,000	60
14	150	43	800	56
16	190-220	62	500	36
18	265-300	80	400	27
24	450-526	120	300	18

F. E. JONES,
New Westminster, B C

DRAINAGE OF IRRIGATED LANDS

WALTER W. WEIR
Drainage Engineer

The drainage of irrigated lands has become a problem whose magnitude almost equals that of irrigation itself. Fully 30 per cent of the irrigated land of the United States could be benefited by drainage or by some of the preventive measures which are used to stop seepage from canals and laterals.

Probably the most important reason why irrigated land needs drainage is that irrigation is an unnatural condition for most of the irrigated soils. These soils have no natural drainage, the capillary drainage channels that are found in the soils of humid sections are often entirely lacking because there has been no water to form them. The soil does not adjust itself to these conditions readily and consequently artificial drainage is necessary.

Another reason for irrigated lands needing drainage is that often very large amounts of water are used in a comparatively short time. It is not at all unusual to learn that 5 to 10 or even 15 acre feet of water are being used during a single season. Only a very small part of this is actually used in the growing of plants and the remainder either is lost by evaporation or seeps into the ground probably to appear at some lower level.

A third cause for damage is the presence of hard-pan streaks in the soil which prevents the percolation of water in the directions it would naturally take. These impervious strata may hold the water table so close to the surface that damage is done or it may form pockets which collect water, or again it may form a passage for the excessive seepage of a canal or lateral.

All soils in arid regions contain alkali to a greater or less degree depending on the degree of natural drainage which the soil has. Gravelly soils which have better drainage than the deep volcanic ash soils seldom develop bad alkaline conditions such as are often found in the deeper soils. Alkali is a broad term used to cover all of the injurious salts, the most common of which are the sulphates, chlor-

ates and carbonates of calcium, sodium and magnesium.

An accumulation of alkali on the surface of land is not the cause of the land being unproductive, but is rather the result of a high water table which is the primary cause for the unproductiveness.

The surface accumulation of alkali being a result rather than a cause, the only permanent method of removing it is to remove the cause, namely the water, and this can be done only by some method of drainage. Alkali being readily soluble in water is brought to the surface by capillary attraction and is deposited as the water evaporates. If then the ground water can be kept in the ground deep enough to prevent its evaporation from the surface there can be no alkali deposited. This depth depends upon so many things that it is difficult to specify exactly what it should be. In coarse grained soils such as sand or gravel water will not rise from as great a depth as in the finer grained soils such as the ordinary volcanic ash of the arid regions of Washington. The condition of the surface of the soil also has its influence on the rise of ground water by capillarity. The water can stand closer to the surface without injury on land that is well cultivated than it can on land whose surface is hard and compact. Land growing crops which shade the land, such as alfalfa or clover, are less subject to alkali than land which is bare. Under ordinary conditions and in soil similar to that which is ordinarily found in the Yakima valley, the ground water should never be allowed to come closer than five and one-half or six feet of the surface.

One of the fundamentals of drainage in irrigated sections is not only to take off surface water but to maintain a water table below the limit of capillarity and to do this it is generally necessary to have drains at least six feet deep.

The gridiron system of tiling which is used in the humid sections is seldom employed in irrigated sections as the water generally comes from some definite direction and can be intercepted or cut off by drains located so as to catch the water before it reaches the land.

It is very essential that the individual tract to be drained be carefully studied as to subsurface conditions. By this is meant that a drainage system cannot be accurately planned without a definite knowledge of where the water is coming from, the location and depth to hard-pan if there is any, the nature of the subsoil, whether sand, gravel or loam and the nature of the surrounding land, whether irrigated or dry, flat or sloping.

In gravelly soils or soils with a gravel subsoil it will be almost universally found that the water is traveling in the gravel and that such lands drain readily and for a considerable distance from the drain. On account of the distance that this kind of land will drain the principal difficulty is in determining the amount of water which it will be necessary to handle.

In land which has a hard-pan stratum or strata beneath the surface, the difficulties are increased. It may be found that water is traveling on top of the hard-pan or it may be beneath or both above and below. If the water is below the hard-pan it is often found that it is under slight pressure and is forcing its way up through the hard-pan. In such cases drains located so as to cut through this strata will often relieve the pressure and carry away the excess water. When the water is found to be on top of the hard-pan some method of intercepting it should be planned. It is not always possible to reach this water at the proper place and depth to give relief, and it must pass too close to the surface before reaching the drains.

Dynamite has been used to break up the hard-pan strata so as to allow a freer passage through the soil, where it is closer than three or four feet to the surface. It is seldom that by dynamiting the land alone relief can be secured, as there must be some means provided whereby the water can escape. Hard-pan can be successfully broken by exploding from one-half to one stick of 20 per cent stumping powder at intervals of 15 to 25 feet. The depth and distance apart should be governed by the depth and thickness of the hard strata.

Attempts have been made to rid land

of alkali by flooding when no under drains are provided. This method can never give more than temporary relief and may do a great injury. It should always be remembered that alkali is very soluble in water and that the first water which touches it will dissolve the salt. When flooding is resorted to the first water added sinks into the ground carrying the salts down with it. The more water that is added the deeper the alkali is taken and the farther away it is from the very water that is expected to remove it. The black stain that is seen in the water used for this purpose is not all alkali, but is largely humus and vegetable matter from the soil and should not be removed. Aside from removing some humus the already high water table in the ground is raised and conditions will soon be worse than before. If, however, the land is provided with underdrains the water which sinks into the soil is taken up by them and carried away, taking with it the alkali. This then suggests a means of removing the surface alkali from a tract that is provided with underdrains.

To remove the surface alkali from a tract provided with underdrainage it should be irrigated freely to carry the alkali down and cultivated so as to retard evaporation from the surface which prevents it from returning. If it is desired to raise a crop on this kind of land a crop should be chosen which requires considerable water and constant cultivation. There are difficulties encountered in the installing of drains in volcanic ash soils that are not found in most humid sections. This soil when saturated with water becomes very difficult to handle as it flows into the ditch or trench almost as fast as it can be dug out. It is quite often necessary to line the trench with sheeting before any work can be done in it. This is accomplished by digging down to the surface of the semi-fluid soil and from there driving down sheet piling of either lumber or metal. These must be made very tight and driven from two to five feet below grade. It is nearly always necessary to construct some kind of a box or flume in the bottom of open ditches which are constructed in this soft material. After a drain has been in place for a time the soil becomes settled and the drain can be deepened or the box removed.

On account of the fineness of the soil it is best never to use tile of less diameter than four inches, and six is often better. The soil entering a three-inch tile will soon fill it up, while the larger sizes can be cleansed by flushing. The small sizes are much more likely to be displaced than the larger and their efficiency decreased.

In summing up the drainage situation in irrigated sections the secret is to know your conditions and then proceed with a definite knowledge of what is going to happen. In this way costly failures may be avoided and successful systems installed.

Dropping of Fruits. See under *Fruits, Setting and Dropping*.

Drought

Curious Benefits

Drought is dreaded by farmers and gardeners because it injures grass and grain, fruits and flowers; but scientific observers testify that it brings, as a compensation, subtle gifts which enrich the soil and increase future crops.

Nature has stored in the earth a rich supply of phosphates, silicates, carbonates and other chemical salts essential to vegetable life. Those on the surface of the ground are soon exhausted, and the large supply at greater depths is often unreached by subsoil plowing.

But a drought is nature's subsoil plow to bring up the rich nutriment below. When the surface is parched, the sun draws moisture from the deeper soil, and this moisture brings with it, in solution, salts of lime and magnesia, of potash and soda. The moisture evaporates, but leaves the salts for the use of plants and grain.

Drought, therefore, does a double work. It parches the surface and lessens the present crop. It forces up rich nutriment from the deeper soil and enlarges future crops.

Drought in Middle West

In the Middle West perhaps no one thing causes greater loss to the fruit

grower than the lack of rain when needed. Any method of treatment, therefore, which will enable us to mitigate this effect, even in a small degree, is well worthy of our most careful attention. How then shall we treat our orchards in order to retain for the use of the trees the greatest possible proportion of the rain which falls upon and among them? It is simply a question of evaporation, and whatever prevents the evaporation of water from the soil is a benefit to the tree and an aid to fruit production. The means of preventing evaporation which naturally suggests itself first is some kind of a mulch to cover up the soil protecting it from sun and wind, and thus keep it from drying out. But how are we to secure such a mulch? To cover the ground with straw or any other coarse material to a sufficient depth to properly protect it is a tremendous job and very expensive, when we come to consider both the value of the material and labor of applying it. Moreover, there is a disadvantage in a mulch of that kind, in that it induces the roots to run near the surface, thus limiting the area from which they can obtain their fertility and rendering them unusually subject to injury from drought in the future should the mulch at any time become deficient. Strange it is how many of our lessons we need to learn through the teaching of what seems a misfortune. We mulch our corn fields, not so much because we want to, as because we have to. Why? Because Dame Nature has filled the soil with a multitude of weed seeds which spring up and grow so vigorously that they practically choke down the corn unless we destroy them. To rid the ground of these weeds we must cultivate, and in doing this we leave a layer of loose mellow soil on top of the ground, which is really the most satisfactory mulch we can get. It needs to be often renewed to be sure, for every shower packs it down so that to a certain extent it loses its value as a mulch. It is only when it remains light and mellow that it serves this office as it should.

Here then is the key to the solution of the problem, namely, frequent surface cultivation at least every ten days or two weeks throughout the season. In some experiments reported by Professor Roberts, of Cornell University, the daily evaporation from soil in a warm room, but not in the sun, was found to be at the rate of from one to two tons of water per acre less from portions stirred to a depth of one and one-half inches every day than from that not stirred. The difference varied greatly with the kind of soil. * * * FRED W. CARD,

Nebraska Agricultural Experiment Station

Dry Farming

We have a good deal of literature published now on the subject of dry farming. Really there is no such thing as dry farming, for no vegetation will grow without moisture. The terms are comparative. In all of the so-called dry farming districts there is more or less of moisture, generally about 15 to 20 inches of rainfall per annum. The question is, how to conserve this moisture so as to profitably grow crops, especially those crops that are necessary to support a farming population with a fair percentage of merchants, mechanics and the classes that depend upon the farming population for a living. In so far as our interest in the subject is concerned, the question is, how to grow fruit. We are not treating the general subject of agriculture, we are treating the specific subject.

There are a great many places in the United States, where by proper cultivation and by the proper selection of trees that will grow fruit with the least possible amount of water, the farmer could have at least a home orchard, or in some instances might produce commercial fruits. The almond requires very little water; certain varieties of peaches and plums will grow on comparatively arid soil. We have seen plums growing wild in some arid districts where there was not more than 20 inches of rainfall per annum. Then among the apples perhaps the Wagener and the Grimes Golden will grow successfully with less water than most other varieties.

Volumes have been written upon the subject. Professor W. C. Palmer, of North Dakota, has produced what he calls the "Ten Commandments of Dry Farming." They are given here as he has written them, because they seem to condense into very small space nearly all the information that we have ever seen on that subject:

I. *Thou Shalt Plow Deep.*
- Lets rain get into soil easily.
- Lets in big rain without run off.
- Provides more feeding space for plant roots.
- More plant food made available.

II. *Thou Shalt Keep the Surface Soil Loose.*
- Keeps soil moisture from evaporating.
- Lets rain get into soil easily.
- More plant food made available, due to more moisture.
- Harrow the grain after it is up two inches or use weeder.

III. *Thou Shalt Cultivate Level.*
- Level soil has the least soil exposed to the air.
- More evaporation from a ridged soil.
- Level soil will take in rainfall much faster than ridged soil.
- On ridged soil the rain runs off through furrows.
- The soil in the ridges dries out so that the plant has less moist surface soil to draw on for food and moisture.
- Ridging the soil is a most effective way for getting rid of both the moisture in the soil and of rainfall.

IV. *Thou Shalt Summer Fallow When the Rainfall Is Less Than Fifteen Inches.*
- The summer fallow saves up two years' rain for one crop.
- The summer fallow kills weeds and plant diseases.
- The summer fallow should be cultivated
- When rainfall is over 15 inches corn will be as good a preparation for a crop as the bare fallow.

V. *Thou Shalt Add Organic Matter to the Soil.*
- Holds moisture and plant food.
- Improves mechanical condition for the soil.
- Helps make plant food available.
- Lessens drifting and blowing of the soil.
- Lessens washing of the soil.
- Stable manure is the best form.
- Plow weeds under when green.

VI. *Thou Shalt Keep Down the Weeds.*
- Weeds use up moisture.
- Weeds use up plant food.
- Weeds crowd the plants.
- Weeds shade the crops.
- Weeds make it difficult for the plants to grow.
- Weeds make it hard to work the land properly.

VII. *Thou Shalt Grow Early Maturing Crops.*
- Growing conditions best in early summer.
- Winter grains better than spring grains.

VIII. *Thou Shalt Grow Corn Every Three to Five Years.*
- The cultivation given corn saves moisture.
- The cultivation given corn kills weeds.
- The cultivation given corn kills plant diseases.
- Corn best preparation for a grain crop.
- Corn produces fine stock food, both grain and fodder.
- Corn produces more per acre than other crops.
- Do not hill up the corn, as this wastes the moisture.

IX. *Thou Shalt Grow Clover or Alfalfa Every Few Years.*
- Clover and alfalfa add fertility to the soil.
- Clover and alfalfa add organic matter to the soil.
- Clover and alfalfa kill weeds and plant diseases.
- Clover and alfalfa produce a most valuable hay.
- Clover and alfalfa produce very valuable seed crops. .

X. *Thou Shalt Keep Stock.*
- The most profitable way of marketing grain and fodder is through stock.
- They produce manure, which is very necessary to the soil.
- They bring about prosperity.

Some Misconceptions Concerning Dry Farming

"The following misconceptions concerning dry farming may be mentioned as among the most serious: (1) That any

definite 'system' of dry farming has been or is likely to be established that will be of general applicability to all or any considerable part of the Great Plains area; (2) that any hard and fast rules can be adopted to govern the methods of tillage or of time and depth of plowing; (3) that deep tillage invariably and necessarily increases the water holding capacity of the soil or facilitates root development; (4) that alternate cropping and summer tillage can be relied upon as a safe basis for a permanent agriculture or that it will invariably overcome the effects of severe and long-continued droughts; and (5) that the farmer can be taught by given rules how to operate a dry land farm."

E. C. Chilcott,

U. S Department of Agriculture Yearbook 1911.
E S R. 27-6

Dry Land Farming. See *Apple Orchard, Cultivation of.*

Duty of Water. See *Irrigation.*

Dwarf Apple. See *Apple, Botany of.*

Eastern Apple. See *Apple, Botany of.*

Education in the Common Schools

Agricultural

In an article of this character for a work on horticulture, we are necessarily more or less restricted to those portions of the subject which relate to our work and the purpose for which it is published. However, in order that we may have a proper setting for that department of the subject suited to our purpose, it is pertinent that we should outline the subject of education and then perfectly treat that part of the subject which is adapted to our work. In a general outline, we have seen nothing that seems to us clearer and more logical than that by Herbert Spencer, who says that a child should be taught to avoid the dangers of many kinds through which he must pass in order to live. These dangers imply the perils of accident, diseases, temperature, climate, environment and all those things that might affect the organism unfavorably. Second, he should be taught those things that pertain to self-sustenance. He should know how to provide for himself and not be dependent upon the intelligence and the labor of others for those things which are necessary to sustain life. Third, he should be taught those things that pertain to social relations, of marriage, the family and society in general, and be able to meet the conditions necessary in order that he may act the part of a good citizen. Fourth, he should be taught those things that tend to unfold the mind, develop and strengthen the character and that tend to the refinements of life.

This is not quite a complete outline of Spencer's "Philosophy of Education," but it gives the main points and seems to cover the ground so thoroughly and to be so clear that we have adopted it here. Now, in relation to education in agriculture or horticulture in the public schools, we are confronted with that question in a very practical way in that it is being carried on throughout the whole country. On the question of vocational training in the public schools, students are being taught home economics and mechanics. Boys are taught how to handle tools in carpentering and various other things relating to those occupations which they will probably follow when they grow up to manhood and are charged with the responsibilities of life.

In ancient times and during the Middle Ages, education was for the most part the privilege of a few persons, mostly of the aristocratic classes who ruled the masses and these masses were kept in ignorance. With the growth of the democratic and republican ideas of government, there has grown up a tendency to educate the masses, and to do so at the public expense. Under the old system of education, emphasis was given to the classes. Probably this was true in part, because science did not occupy the broad field which it has come to occupy with the new discoveries of truth through the means of the telescope, microscope and other instruments used for investigation and discovery. Now that science is so large a part of the sum total of human knowledge, and

that it is so important in order to succeed in any particular calling or business, it is necessary that the student should know many things that years ago were not a part of human knowledge.

We must educate in chemistry if our pupils would fairly understand many of the things with which they have to deal, practically. There must be some knowledge of bacteriology if we are to intelligently control many of the diseases that affect our crops. We must have some knowledge of plant physiology if we are to know the laws of plant life and succeed in the highest degree in the growing of crops. We must have some knowledge of climatic conditions and the adaptations of different kinds of crops to climates. We have come to know that no particular department of work and no particular law exists alone but all things are inter-related. It would seem proper in an agricultural country, that the students in the public schools should be taught those things that pertain to agriculture or if we particularize in horticulture, it would seem proper that they should be taught those subjects which relate to the dominant industry in the community in which they live. There is greater probability that the son of a farmer will be a farmer, provided the farm can be made to pay, than that he will follow any other vocation. In like manner, there is greater probability that the son of an orchardist will be an orchardist, provided the orchard can be made to pay, than that he will leave the orchard and go into some occupation with which he is not familiar. Considering the importance of agricultural subjects, using the word agriculture in the broad sense to include horticulture, it would seem entirely proper to teach in the public schools those things that relate to the most important industry in the world, and this is more especially true when we come to consider that in the teaching of those subjects, we are giving as good mental discipline, as good training, and as large an information with reference to the things of life as could be given in any possible course of education that can be pursued, and that in so far as it concerns self-sustenance and the sustenance of those dependent upon us, it is much more important than the classical courses that have generally been mapped out. This might not apply to persons who expect to acquire a living by teaching the classical courses in the schools, but these persons are exceptions.

The masses of men must always do the practical work of life, and in order to do it well, they should be trained as early as possible to know how to do those things that they must in future years do in order to live.

Carroll D. Wright, in his outline of "Practical Sociology," says:

"That part of the public school system which interests the greatest number of persons is to be found below the grade known as the high school, for probably 90 per cent of the children passing through our public schools leave them at the grammar grades, or the highest grade under the high school. Public interest is therefore largely centered in the perfection of the primary, intermediate, and grammar grades, in which many a child is taught all that he will ever receive in the way of education before entering upon his life work."

GRANVILLE LOWTHER

Methods in Agricultural Education

Nearly every one today believes that our schools must become more closely allied to the industries by which our people live. But our power and prosperity in the future depend upon the skill and the intelligence by which our people are able to practice the arts of agriculture and horticulture.

It is easy to agree that the schools shall take in agriculture. But it is tremendously difficult to find out just how this may be done. No one knows as yet. There must be myriad experiments and a thousand grotesque failures before we succeed. The casual observer does not dream of the difficulties and stumbling blocks in the way. It is the work of years to get a new idea really planted and growing in the set

conservatism of a social institution like our school system. There is danger, when professional educators take hold of a live and vital thing like agriculture, that they take all the real live interest out of it in order to teach it in a conventional way. When it becomes embalmed in regular text books, perfunctory recitations, and periodical examinations, it fails of its true mission. If it would truly succeed, ways must be found to keep it alive, to keep it in touch with country life, to invest it with the realities of extracting a living from the soil.

Teachers of agriculture are not yet bred. Hundreds of years have been spent in growing good teachers of mathematics, literature, language—let us not be run away with by the notion that we can build up an agricultural Rome in a day. It is necessary to have some foundation for any kind of building. It is highly desirable to instil a spirit of sympathy for agriculture into the minds of all the people and to bring them into actual contact with the agricultural life. For many generations everything in education has tended away from the farm. The district school never does one thing in all its curriculum to prepare the boys and girls for a living on their fathers' farms. It heads them rather toward clerkly or professional pursuits in the town or city.

The object of this article is to call attention to the fact that we must find something different from the traditional text book method of approach if we would really get the genius of agriculture into the public schools; to name two or three methods of approach that are different, and to suggest that the best plan for a school to undertake agriculture is by finding ways to co-operate personally with the nearest agricultural industry, by actually entering into its spirit and its labors.

A movement has started in the prune orchards of the Santa Clara valley, California, that bears directly upon these educational questions. The idea is to enlist the interest and the labor of the children and the people of the villages and towns in the harvesting of perishable fruit crops, paying them full market wages for their work, furnishing them safe and attractive camping places, facilitating their coming and going, and giving them a season of healthful, active outdoor life. This is a practical course of study in California agriculture that may well command the co-operation of the educational forces of the state.

The school term may very well begin and close so that the children and their parents can take part in the chief industry of the neighborhood.

The raising of a school garden is a most delightful and practical method of approach. Not all teachers have the knowledge and sympathy that make for the highest success, but nearly all come of ancestry that lived by the soil; and if their minds are open, their hearts willing, the old interest will come back. Not all rural schools are adapted to gardening, but many of the most successful school gardens are raised at the homes of the children.

Most of the things we now teach would group themselves about and grow out of this practical life—arithmetic, bookkeeping, nature study and science. And let us remember that the thing does not even need to be a commercial success in order to be successful educationally. * * * Failure is as natural as success—probably more so. If the bugs get away with the crop, if neglect of a certain point cuts out the profit, if the season was unfavorable, if the frost came too late, was the enterprise then destitute of value, and a fair mark for clumsy and thoughtless wit? By no means. It is real life, and it is doing the work it set out to do, no matter whether the actual returns were large or small.

It is the experience of many states that the most efficient approach to agriculture is by the organization of boys' and girls' agricultural clubs. These are formed for some specific and tangible purpose, as a competition under certain rules in the growing of wheat, or potatoes, or cotton, the raising of poultry or gardens, the baking of bread, the canning of fruit. New York is the pioneer.

Under the direction of Cornell University this state began work in 1898. It now has a membership of 75,000 boys and girls in its clubs, and has for its official organ the Cornell Rural School Leaflet, that goes to 7,000 teachers. Nebraska began this work in 1905, devoting its chief energy to the growing and the cooking of corn, under directions and recipes sent from the State University. In the counties, and finally for the state, with a "corn banquet," bringing together 2,000 to 3,000 boys and girls from all over the commonwealth. The county superintendents of Winnebago county, Illinois, and Keokuk county, Iowa, have made national reputations in this work.

An agricultural club may be organized in a single school, and may do enthusiastic work. It is larger and better for the whole county to undertake it. Ambitious county superintendents of schools in the rural regions have an inspiring opportunity for usefulness in this field. There should be means provided for public displays of the results of competition. There should be some periodical to knit the organization together. There should be some leader who can travel about among the different clubs encouraging them and telling them what their fellows are doing. Doubtless the time will come when the superintendents and teachers of agricultural counties will be chosen for enthusiasm and skill in this very kind of work. There is a fascinating field lying ready, a field for fame as well as for the highest service to the state.

EDWARD HYATT,
California State Superintendent of Schools.

Egg Plant

The egg plant is a native of the warm countries, but has become adapted to almost all parts of the United States. Professor Beattie describes its cultivation as follows:

The plants for this crop should be started and handled in the same manner as for the tomato. After the weather has become settled and the ground quite warm, set the plants in the garden in rows 3 feet apart and 2 feet apart in the row. The soil best adapted to the production of egg plant is a fine, rich sandy loam and should be well drained. Cultivate freely and keep the plants growing rapidly. Many growers believe that fresh stable manure should not be used in connection with the growing of egg plant and that the land should not contain unfermented vegetable matter to any extent.

Egg Plant.
—*Maxted Photo.*

Egg plant is used in several ways, among which are the following: Peel and cut into slices one-half inch thick, soak in salt water one hour; boil until tender; then coat with rolled crackers or flour and fry in butter or fat. Another method is to steam or bake the egg plant whole and serve in the shell, the pulp being eaten with salt, pepper and butter.

Varieties

Black Beauty, Early Long Purple, Early Dwarf Purple.

EGG PLANT DISEASES

Anthracnose

Gloeosporium melongenae, Ell & Hals.

The anthracnose fungus of egg plant attacks the fruits of egg plant and causes

spots in them. These show early as pits in the surfaces of the fruit which show the usual border.

Bacterial Blight

Bacterium solanacearum Erw. Sm.

The common solanaceous blight organism attacks the egg plant as well as the potato and tomato. Where attacks occur destruction of the affected plants is all that can be done.

Fruit Rot

A fruit rot of egg plant likewise occurs and may at times appear as a leaf spot fungus. This, like the anthracnose and leaf spot, should yield to treatment by sprays. Ammoniacal copper carbonate may be used toward the ripening period.

Leaf Spots

Two or more leaf spot fungi have been recorded on egg plant.

Rot

Botrytis

A mouldy decay of fruit giving a dusty appearance. Not serious.

Stem Rot

Nectria ipomoeae Hals.

The stem rot fungus of sweet potato has been described upon egg plant by Dr. Halsted. The conidial stage is evidently a species of fusarium and it may or may not be a different one from that with which we have to contend upon the potato; it is recorded by Dr. Halsted as the same that occurs on sweet potato.

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EGG PLANT PESTS

GREENHOUSE WHITE FLY. See *Cucumber Pests.*

HARLEQUIN CABBAGE BUG. See *Cabbage Pests.*

RED SPIDER. See *Apple Pests.*

EGYPTIAN BEET FOR ALASKA. See *Alaska.*

EGYPT, IRRIGATION IN. See *Irrigation.*

Elderberry

The elderberry is the purple, black, drupaceous fruit of the common elder, having a sweet, acidulous taste. The shrub belongs to the *genus Sambucus* of the natural order *Caprifoliaceae.* There are about 20 species characterized by opposite pinnate leaves, small white flowers, usually in compound cymes, and black, red, white or green juicy fruits. They are not grown largely for home use or for the market. They succeed well on nearly all varieties of soil, but are found more frequently along the streams, in rich, sandy loam, and grow successfully in nearly all the states. They are easily propagated by means of root or stem cuttings, and are often grown for ornamental purposes, since they grow rapidly, are rather graceful in appearance, and grow to a height of from 8 to 12 feet.

The fruits are used for making pies, jellies, and elderberry wine. The wine has rather a pleasant taste, and is said to have some medicinal properties, especially for asthmatics.

* In considering the possibilities of the elderberry it is well to first mention its good points.

1. Late blooming, being absolutely beyond danger of late spring frosts.

2. Sure cropping. I think that there has not been a failure of the wild elderberry crop for 30 years.

3. Freedom from disease. So far I have not noticed any disease on the elberberry.

4. Freedom from insects. So far as I know there is only one insect troublesome to the elderberry.

5. Ease of gathering the fruit. The berries grow in large bunches, easily picked and there are no disagreeable thorns to interfere with the operation.

6. Time of ripening. The elderberry ripens just after the blackberries are gone and fills in a period otherwise without berries.

There are some bad features about the plant, chief to be mentioned being the

* F. C Pellett, Iowa State Horticultural Society, 1909.

difficulty of eradicating it when once it becomes established. But this might prove a desirable feature once a market was created for the fruit, as a plantation would be well nigh permanent and would require the minimum of attention.

By itself the elderberry sauce is a little insipid but with a few drops of apple vinegar added it is unsurpassed for pies and mixed with rhubarb makes splendid sauce. A mixture of apples and elderberries makes a good jelly.

As an ornamental shrub also the elderberry is worthy of a place.

If we can succeed in making as great improvement in this fruit as has been made in the native wild grape in producing the Concord, we will have a fruit equal to anything now on the list, but of course it will require a long period of painstaking experiment. On our grounds the clump that gets the wash water near the kitchen door produces much larger bunches and larger berries than those carefully cultivated in the garden.

GRANVILLE LOWTHER

ELEMENTS REMOVED BY VARIOUS CROPS. See *Apple Orchard Cover Crops.*

Endive

A salad crop, grown for its blanched leaves about the same as head lettuce. In the Southern states, it does better as a fall than as a spring crop.

"Sow the seeds thinly in drills, and when the plants are well established thin to 8 inches. Water and cultivate thoroughly in order that a good growth of leaves may be made. When the leaves are 6 to 8 inches in length draw them together and tie them so the heart will blanch. The leaves should not be tied up while wet or decay will follow. The heads should be used as soon as blanched. For winter use sow the seeds rather late and remove the plants, with a ball of earth adhering to the roots, to a cellar or cold frame, and blanch during the winter as required for use.

"Endive is used as a salad at times of the year when lettuce and similar crops are out of season."

ENGLISH WALNUT. See *Walnut.*

EUROPE AS FRUIT MARKET. See *Market.*

EUROPEAN GRAIN APHIS ON APPLE. See *Aphids.*

Evaporation of Apples

The utilization of the poorer grades of fruit is frequently an important matter to the grower. That portion of a crop which is of too low grade to market in the ordinary way can often be made to pay a large part, at least, of the expense of maintaining the orchard if it is converted into some other form than that practiced with the better grades. In some of the apple growing districts the evaporating industry has kept pace with the planting of orchards and has become an important factor in the utilization of the fruit which is unfit or would prove unprofitable for marketing in the fresh state. In some of the older apple growing sections, such as Western New York, the number of evaporators in use is very large, and for many years the industry has been well established. Its present state of development, however, has been a matter of gradual evolution. During its course methods have changed more or less, appliances have been perfected, and marked improvement in the construction of the evaporators themselves has been accomplished.

Many evaporators are located in villages, at railroad stations, and at other central points; a considerable number, however, are erected in close proximity to or in conjunction with apple orchards, owned and operated by the fruit growers themselves, each plant being intended only for "working up" the fruit not otherwise marketed from a single orchard. The evaporators located in towns or villages are usually operated by men who make a business of evaporating fruit, and the apples handled in them are bought wherever they can be obtained to best advantage. These are generally of much larger capacity than the ones at the orchards, and the type of construction and the character and number of conveniences correspond.

The average weight of ripe winter apples of mixed varieties is about 50 pounds to the bushel. In evaporating them about

40 pounds of water per bushel, or approximately 5 gallons, passes off in the form of vapor. The evaporating of apples may be said, in brief, to consist of driving off as rapidly as possible, by means of artificial heat, enough of their moisture to prevent deterioration through decay or other natural processes which occur in fresh fruit and at the same time to maintain a desirable texture and flavor.

Buildings formerly used for other purposes are frequently converted into evaporators. An old dwelling house, a blacksmith shop, a cheese factory, and even a school house and a church are examples. Others are built substantially of brick or stone, thus reducing the risk from fire, which is an important consideration.

A large quantity of fruit, in the aggregate, is still dried by primitive methods. In rural communities, especially where the "home orchard" represents the extent of fruit growing, one often sees during the autumn a flat-topped rock, the roof of some low, easily accessible shed, or other flat surface on which have been spread apples, sliced or quartered, for drying in the sun. In some sections "strings" of quartered apples hanging by a doorway to dry, or behind a kitchen stove, are still familiar sights.

While much of this sun-dried fruit is intended for home use, large quantities of it are marketed, and it is also exported to some extent. This fruit is commonly referred to as "dried apples," in distinction from that handled in evaporators, which is known as "evaporated apples."

Types of Evaporators

Many types of evaporators are now in use, though in a general classification they may be grouped, for convenience, under a few heads. The more important of these are:

1. Cook stove evaporators.
2. Portable outdoor evaporators.
3. Kiln evaporators.
4. Tower evaporators.
5. Miscellaneous types.

It is well to emphasize, at this point, the fact that the descriptions which follow are representative of types only and that the details of construction and arrangement admit of endless modification. For the most satisfactory results, however, in all types, thorough ventilation is essential to insure a good circulation of heated currents of air.

Cook-Stove Evaporators

Some of the cook-stove evaporators are small box-like structures, usually made of sheet iron or galvanized iron, of such a size that they can be placed on top of an ordinary cook stove. They are arranged for holding a series of small trays, on which the fruit is placed after it has been prepared for drying. Various sizes are in use, from one covering only a portion of the top of a common kitchen stove and having a capacity of only a bushel or so a day, to those requiring the entire top of a stove on which to operate it.

Another style consists of a watertight rectangular box of tin, upon the upper surface of which the fruit is spread. The heat is supplied by boiling water, with which the evaporator is filled, the temperature being maintained by placing one end of the evaporator on top of a stove. There are various other styles of this type.

Portable Outdoor Evaporators

Portable evaporators are especially convenient when it is desired to dry only a few bushels of fruit at any one time. The usual sizes have a capacity of 5 to 10 bushels a day, and even more in some cases, although the quantity will of course vary with the attention given to them. As they are complete in themselves and are not too heavy to be readily moved, they may be placed wherever convenience from time to time dictates.

There are other styles of this type obtainable from manufacturers which are made of sheet iron, usually galvanized. As no wood enters into their construction, danger from fire is eliminated. One of these styles is provided with a heat deflector and so constructed that hot currents of air pass over the fruit as

well as up through it, the claim being made that this movement of air induces a more rapid drying of the fruit than in ordinary methods of construction.

Kiln Evaporators

Of the types having sufficient capacity for handling apples from large commercial orchards, the kiln evaporator is by far the most important.

While the principles of construction of the different evaporators of this type are similar in all cases, the details and the arrangement of the appliances are endlessly varied.

In constructing kilns the same general principles are followed, whether the evaporator is a small one with only a

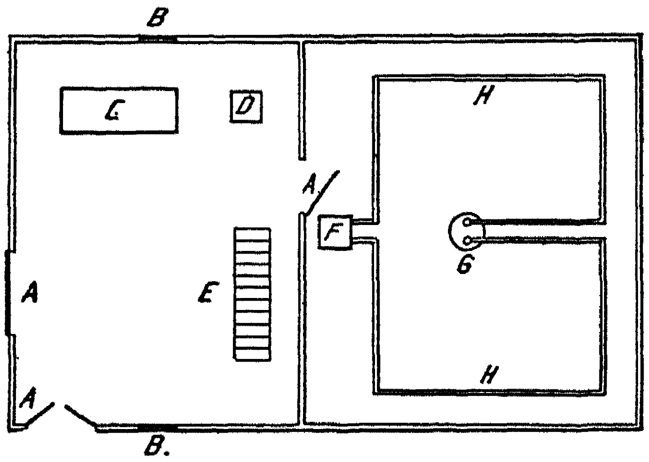

Fig 1. First-floor Plan of an Evaporator, showing the arrangement of the principal details A, doors, B, windows; C, paring table, D, bleacher; E, stairs; F, chimney, G, furnace; H, pipes.

single kiln or an extensive establishment having several of them. The most satisfactory size of kiln, all things considered, is about 20 feet square. This is a convenient size to fill, so far as the preparation of the fruit is concerned; the heat can be well regulated, made sufficiently intense for the purpose desired, and evenly distributed, so that the fruit will dry uniformly, and for various minor reasons a kiln of this size is a desirable "unit" in the construction of evaporators of this type.

A kiln consists essentially of a floor made of slats and placed over a furnace room or over a system of steam pipes. The floor is usually built from 10 to 12 feet above the floor of the furnace room. Provision should be made for regulating the heat by means of small openings at the base of the walls, communicating with the outside, which can be opened or closed as desired The inflow of cold air can thus be regulated. Such control is especially desirable in windy weather. While many evaporators are constructed without special provision of this kind, it is an important point to have such openings, particularly if the walls are brick or otherwise made very tight, so that there is but little circulation of air.

If the evaporator is a frame building, the walls of the furnace room may well be plastered or covered with asbestos paper to lessen the danger of fire, which may otherwise be great, because of the intense heat generated within them.

If the walls, at least the portion below the kiln floor, are double, with an air space between the two sides, the insulation will be more perfect than if they are solid or of only a single thickness, thus best conserving the heat and increasing the efficiency of the plant. The height of the walls of the kiln above the drying floor should be sufficient to permit an attendant to work on the floor conveniently and with comfort.

Some means for the escape of the air laden with moisture from the fruit is necessary. This may be provided for by means of an opening in the roof, or a cupola-like ventilator may be built, the sides of which should consist of slats placed so that they overlap one another as in an ordinary window blind. Another form of ventilator is in the form of a tower about 3 feet square and extending 8 or 10 feet above the roof, which is sufficiently high to cause more or less draft, and hence augments the circulation of hot air through the fruit.

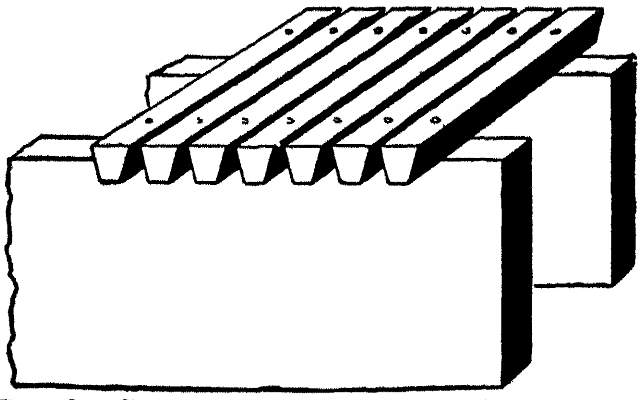

Fig 2 Section of a Kiln Floor, Showing the Method of Construction.

The kiln floor is constructed of strips especially designed for the purpose. Such floors are generally made of poplar or basswood strips, seven-eighths of an inch thick, one inch wide on the top surface and one-half inch wide on the under side. In laying the floor, these strips are placed one-eighth to one-fourth inch apart on the upper surface. This makes the space between them wider on the under side than on the upper, thus allowing the small particles of fruit which work down between them to drop through without clogging the intervening spaces. Reference to Fig. 2 will make plain the method of constructing the floor.

The heating apparatus, parers, slicers, bleachers, details of arrangements, etc., referred to here are described under their respective headings.

Tower Evaporators

At one time tower evaporators were extensively used in some sections for apples, but in recent years this type has been largely superseded by the kiln evaporator, so that at the present time there are comparatively few towers in use.

As the name of this type implies, a tower is its characteristic feature of construction. It may be likened to an immense chimney, provided with the necessary appliances for receiving the fruit, except that the heat alone is allowed to pass through it, a separate flue being provided for the smoke.

There is no more definitely prescribed manner in which these towers are constructed and arranged than there is governing the construction of kiln evaporators. They may consist of one tower or several. If several, they may be entirely disconnected from one another. They may be built side by side or back to back, opening on the opposite sides. They may be entirely within the building, extending through the several floors from basement to roof and projecting above, or entirely on the exterior, opening into the interior after the manner of an "outside chimney," common in some sections of the country. They may be built either of wood or brick. They are usually from 4 to 5 feet square, inside measure, and 30 or 35 feet in height, as desired. Heat is supplied by a furnace at the bottom of the tower.

There are two principal methods of constructing the towers in regard to receiving and handling the fruit to be dried. The apparatus in one case consists of two endless sprocket chains operating over wheels properly adjusted at the top and bottom of the tower. Each sprocket chain is provided with swinging brackets, corresponding with one another on each chain, for holding the racks on which the fruit is placed for drying. In one specific make of apparatus these brackets are arranged in series of six each, so that this number of racks can be put in, one immediately above another. A space of two feet or so intervenes on the sprocket chains between each series of six brackets. This sprocket-wheel-and-chain device for carrying the fruit in the tower is turned by means of a crank, which works on the outside of the tower.

The racks on which the fruit is dried consist of frames 4 feet long and 21½ inches wide, over which is placed galvanized wire netting having a ¼ inch mesh. This size of rack permits the apparatus on which the racks are carried in the tower to work readily, those on one side passing upward, while those on the other side move downward, without interfering with one another.

In this method the point of admitting the fruit to the tower is near the base on the first floor. When the fruit is dry it is removed at the same point.

In operating the tower, the apparatus is turned every few minutes to bring each rack of fruit in its course to the base of the tower, where the heat is greatest. In this way it is made to dry uniformly, and each rack is brought repeatedly into view of the one in charge; hence he is always able to know its exact condition.

In one particular evaporator of this kind there are three towers, about 30 feet high, each holding 120 racks. The capacity of a single tower is about 100

bushels a day. The fruit is prepared in every detail the same as for drying in kilns.

In the other method the racks are about 4 feet square and occupy the entire cross section of the tower instead of half the space, as in the method just described. The racks are admitted to the tower at the same point as in the other style, but as each rack is put in position it is raised by a lever attachment, together with the other racks which may have been already put in place, and held in the new position by dogs or clutches which work automatically, allowing the racks to be moved upward, but not permitting them to move downward. The distance which the racks are raised each time the lever is moved is sufficient to allow another rack to be inserted below them at the usual point of admission. It will thus be seen that the racks are gradually raised from the point of insertion on the first floor to the point on the second floor where they are removed. The racks do not come into the view of the operator from the time they are inserted until they reach the place where they are removed, and so do not come under the same scrutiny of the operator as in the other style. The arrangement of the furnaces is the same in both methods of construction.

Miscellaneous Types of Evaporators

While the types of evaporators previously described admit of endless modification in the details of construction, and other types and styles of lesser importance are frequently seen, there is but one additional evaporator to which it seems desirable to refer in this connection. The type in question has no particular designating term applied to it. Several styles which possess some features similar to this one have been called "cabinet evaporators," and this term is applicable in the present instance. While it appears to be largely of local reputation, it is believed to possess certain points of merit worthy of more extended application in constructing evaporators of considerable capacity. The fruit is dried on racks similar to those used in tower evaporators.

In the first one of this type to be erected, so far as the writer has been able to learn, and which is still in use, the compartments in which the fruit is dried are located in the central part of a large room in which the fruit is sliced and handled after it is removed from the evaporator. Each compartment, of which there are three, is slightly more than eight feet square, or large enough in cross section to receive four racks (two square) on the same plane. The two opposite faces or sides of these compartments are a series of narrow doors, about six inches wide and slightly more than four feet long, which extend horizontally. These doors are hinged on the lower side and held in place by a button at the top. The sides of the interior are supplied with cleats on which the racks rest. Two racks placed one directly on the other are admitted at each door. In the particular case in question, there is sufficient space between the floor and ceiling of the room for eleven of these doors, each door admitting, as stated, two racks. It will thus be seen that the capacity of each compartment is 88 racks.

As arranged in this evaporator, the racks are admitted to the drying compartments on the same side of the room that the apples are sliced, the ones that are put in first being pushed to the opposite side of the compartment, thus making room for the second set of racks in the course. The attendant in charge of the drying makes his examinations and removes the fruit when dry through the doors on the opposite side of the compartment.

It will thus be seen that the method of handling the fruit is similar to that employed in the case of the tower driers, but the work is all done on a single floor of the evaporator.

The heat is supplied by a system of steam pipes which extend in horizontal tiers through the compartments between the racks.

Evaporator Appliances, Etc.

During the development of the industry, the machinery and other appliances used

in the process of evaporating apples have undergone great changes, until at the present time a high degree of perfection has been attained. Reference to some of the more important articles for equipping an evaporator may be of value to those who are unfamiliar with them. Nearly all of them may be obtained from manufacturers ready for use, hence detailed descriptions are unnecessary in most cases.

Paring Tables

There are two general plans of construction. One consists of a single long table common to all the machines; the other, individual tables, one for each parer.

Where several hand parers are used they are commonly placed on opposite sides of a relatively wide table, through the center of which, between the two rows of parers, is a sluice 10 or 12 inches wide and as many inches deep. An endless belt the width of the sluice covers its bottom. This belt works on rollers and is operated by means of a crank at the outer end. As the apples are trimmed they are thrown into this sluice, and the helper who attends to the bleacher fills the crates or trays in which the fruit is handled by turning the crank which moves the belt forward, carrying with it the fruit which has been placed thereon. By this means all the trimmers contribute to the filling of a single tray, thus making it possible to get all the fruit into the bleacher in the shortest possible time after it is pared. This is considered essential in order to make the highest grade product. Such a table as this is especially adapted to small evaporators which are run entirely by hand power.

In power evaporators a long table common to all the parers is generally used. The necessary carriers for removing the apples and the parings operate beneath the table. If individual tables are used in such cases, a small sluice may connect each table with a carrier which works just beneath the floor, which carrier in turn delivers to an elevator that connects with the bleacher. By thus placing below the floor the carrier which takes the fruit from the tables, the space above is left unobstructed, which would not be the case were the individual tables connected with a common carrier.

Paring Machines

Paring machines are made for operating either by hand or power. The more recent patterns have two, or even three forks for holding the apples while they are being pared. The attendant puts an apple on one of the forks while one on another fork is being peeled.

The number of bushels which can be pared in a given time of course varies with the size and condition of the fruit, but 70 or 75 bushels for a day of ten hours (or even more if the fruit is of good size and the machine is speeded up to its limit) is not an unusual amount for a good power machine.

The hand machines are equally complete and satisfactory in their working. Under favorable conditions an experienced operator will pare 60 or more bushels a day if the fruit is not too small.

Bleachers

In order to make the fruit as white as possible, it is usually subjected to the fumes of burning sulphur. The apparatus in which the fumes are applied is called a bleacher.

The form and manner of construction vary greatly, as do most of the other appliances. The requisites are a perfectly tight compartment having a capacity commensurate with the size of the evaporator and the necessary facilities for burning the sulphur.

Perhaps the simplest form of construction consists of a box sufficiently long to meet the requirements, placed horizontally, and large enough in cross section to admit the boxes or crates in which the fruit is handled. Rollers are placed in the bottom, on which the crates rest, which permit them to be moved along with but little friction. The crates are entered at one end of the bleacher, those previously put in being pushed along to make room for the following ones. The sulphur is usually burned immediately below the point where the fruit is put into the bleacher. A short piece of stovepipe is placed at the opposite end for the

escape of the fumes after they have passed through the bleacher.

Another simple bleacher in which the fruit is handled in bulk (not in crates) consists essentially of a large square box, the interior of which is fitted with a series of inclined planes sloping in opposite directions to prevent the fruit from dropping to the bottom in a compact mass. The fruit is usually admitted at the top directly from the paring table. It then rolls from one inclined plane to another to the bottom, where there is the necessary opening, with means for closing it tightly to prevent the escape of the sulphur fumes, for removing the fruit when it is bleached. The sulphur is burned beneath the lowest inclined plane.

In the case of the bleacher where trays are used the sides of the interior are provided with series of cleats for supporting the trays in which the fruit is handled. The distance between the cleats is slightly more than the depth of the trays. The sides toward the platform consist of series of closely fitting doors about six inches wide, placed horizontally, through which the trays are entered and removed from the bleachers. The trays of fruit are put into the bleachers and left in the sulphur fumes a sufficiently long time for the fruit to bleach. The sulphur is burned at the bottom of the bleachers, and the tall shafts which are to be seen projecting from the top are ventilators, which give sufficient draft to take the fumes up through the fruit and to allow their escape at a point some distance above the workmen.

While all of these types may do the work well, they are so constructed that much handling and lifting of the fruit is necessary.

There is an upright style in common use in some sections, which reduces the lifting of the fruit by hand to a minimum and serves not only as a bleacher, but also as an elevator. This is especially suited to the smaller, two-story evaporators, operated without mechanical power, in which the slicing is done on the second floor and having the kiln floor on the same level. By this means the fruit is raised from the first or paring room floor to the level of the kiln floor while it is being bleached.

The construction is comparatively simple. It consists of an upright box extending from the first floor to three or four feet or any convenient height above the second. The cross dimensions are such as to admit the crates or trays in which the fruit is handled. The crates are admitted to the bleacher at a convenient height, 18 inches or two feet from the bottom, through a trapdoor or some other arrangement which can be tightly closed to prevent the escape of the sulphur fumes.

A movable frame, slightly smaller than the cross dimensions of the bleacher, rests on a solid support just below the point where the crates are entered and on which the crates are placed when pushed inside. This frame is connected with a level at the top of the bleachers by means of iron rods which are attached to a cross arm on the level and extend down the sides of the bleacher to the frame. The relative length of the long and short arms of the level must be such that in the sweep of the long arm the frame on which the crates rest will be raised a distance slightly greater than the depth of the crates in which the fruit is handled. There are dogs, or catches, on the inside of the bleacher, which work automatically and permit the crates to be moved upward, but not downward. When a crate is put in place, the lever is pulled down, usually by means of a rope which passes through the second floor within convenient reach of the helper who handles the crates. The crate which was last put into the bleacher and all that may have been put in previously are raised to the point where they are caught by the clutches just mentioned and so held in that position. On releasing the lever, it regains its former position and the frame drops to its place just below the level of the doorway through which the crates are admitted and is then ready for receiving another crate. A small-sized stovepipe or other tubing should extend from the top of the bleacher to the exterior of the building to permit the escape of the sul-

phur fumes after they have passed through the fruit.

The crates are removed through a tightly closing door in the bleacher on the second floor, where the apples are sliced and spread on the kiln floor.

The sulphur is burned at the bottom of the bleacher, below the point where the fruit is admitted. It is a safe provision to have this portion of the bleacher coated with cement or lined with asbestos, especially the floor, to lessen the danger of fire.

Perhaps the most satisfactory bleacher for evaporators in which an engine is installed is the "power" or "horizontal" type. Its characteristic feature is the movable bottom, or rather false bottom, on which the fruit is carried through the bleacher.

Briefly stated, this bleacher consists of a tight box about three feet square and 20 or more feet long, the length being regulated by the capacity of the evaporator in connection with which it is operated and the time it is desired to bleach the fruit.

The apples are conveyed from the paring room to the bleacher by a carrier, or elevator, similar to those already referred to, and are dropped into one end of the bleacher, falling on the movable bottom, which consists of an endless belt of "lugs," turned by the proper gear attachment. The speed of movement is governed by the gearing, and is adjusted to correspond with the time it is desired to keep the fruit in the bleacher and the length of the latter. When the fruit has been carried through the bleacher, it passes to the slicer, which is located in close proximity to the bleacher. The end of the bleacher is closed when in actual operation by means of a closely fitted piece of canvas or other effective arrangement. Provision for the escape of the fumes may be supplied as suggested in connection with the upright type previously described.

Sulphur Stoves

In a large proportion of instances nothing more elaborate than a broken or otherwise discarded iron kettle or some similar receptacle is used for containing the burning sulphur. This is the case if the compartment in which the sulphur is burned is a portion of, or in direct communication with the bleacher. In other instances, such as the power bleacher just described, where in some cases it is more convenient to burn sulphur at some distance from the bleacher, a small sheet-iron stove about a foot square and 12 or 15 inches high is used. This is connected with the bleacher by means of a small stovepipe.

Slicing Machines

There are several styles of slicers now obtainable which are operated by hand, foot, or mechanical power. In general, they consist of a table in which a series of knives is so arranged that when the apples are carried over them by a revolving arm they are cut into slices. In at least one type the apples are delivered to the slicing table by an attachment which works automatically.

The capacity of slicers varies somewhat, as does the industry of the men who operate them, but from 200 to 400 bushels for a day of ten hours may be expected of a good machine.

Small hand slicers which slice only a single apple at a time are sometimes used in the smaller evaporators.

Quartering machines are used instead of slicers, if it is desired to dry the fruit in quarters instead of slices.

Crates and Trays

Crates and trays are essential accessories. A relatively large supply facilitates the handling of the fruit both before and after it is pared, especially where there are no elevators or carriers to convey the fruit from one point in the evaporator to another. They are usually made to hold about a bushel. The bottoms of those in which apples are bleached should be made of narrow slats, and preferably also the sides, to permit a free circulation of the sulphur fumes through the fruit.

Racks

In the construction of all racks on which fruit is dried, whether for use in a large tower evaporator or in a small cook stove type, a special caution should be

observed to select only the best grades of galvanized wire netting for making the racks. If poorer grades are used the acids of the fruit are likely to act on the metals, producing undesirable results.

Heating Apparatus

Satisfactory results are so dependent upon the heating apparatus that this becomes one of the most important features of an evaporator.

In the smaller types of evaporators, where comparatively little is involved and the question of fuel does not enter seriously into consideration, almost any small stove commensurate with the size of the particular evaporator in question may be used.

In the larger kiln evaporators the matter is a more important one. Formerly, ordinary cast-iron stoves were used considerably, two or more of them frequently being required to heat a single kiln, but these have largely gone out of use. In their stead large furnaces are now most commonly used. These are specially designed for the purpose and are provided with relatively large fire pots, correspondingly large ash pits, and large radiating surfaces. As it is necessary to burn a relatively large quantity of fuel in a given time, the size of the grate is made with this end in view. For a kiln floor 20 feet square, or 400 square feet of surface, the grate surface is usually about three feet in diameter, containing from five to seven square feet.

As to the most satisfactory length of pipe connecting the furnace and chimney, opinions differ. Perhaps the most common method of piping is the following: The furnace, with two flanges for attaching the pipe, is placed in the center; the pipe from each flange is then extended to the side of the room opposite the chimney, and from this point the two sections, extending in opposite directions, follow the wall, at a distance of two or three feet from it, to the chimney. In a kiln 20 feet square, some 65 or 70 feet are thus required. Ten-inch pipe is a common size to use for this purpose. It is placed about three feet below the kiln floor.

Some operators think that a better distribution of heat is obtained if the pipes extend back and forth, two or three feet apart, under the entire floor of the kiln, thus requiring 200 feet or more instead of the shorter length above suggested. The greater length, however, is less frequently used than the smaller.

In some cases the heat is so intense directly over the furnace that the fruit dries more rapidly in the center of the floor than about the sides. To regulate this and make the drying as uniform as possible, a "deflector," consisting of a piece of sheet iron or tin several feet square, is attached to the floor directly above the furnace.

Open grates, which in effect are furnaces with all parts above the grates removed, are used occasionally and are recommended by some because they require less fuel, less attention to firing, and will dry the fruit in a shorter space of time. On the other hand, so much dust rises from them that they are not used in making the best grades of fruit.

Tower evaporators may be heated by the same style of furnaces that are used in kiln driers. The size of furnace sufficient to evaporate a given quantity of fruit in a given time is probably about the same in either type of evaporator.

In some respects a steam system is the most satisfactory method of heating, but it is comparatively little used, possibly due to the larger first cost of installing such a system. It is especially applicable in case of evaporators that are operated in connection with some other business that requires the use of considerable steam power, such as a large cider mill, which requires the power for running the presses.

In kiln evaporators the steam pipes are generally placed in as close proximity to the floor of the drying room as is convenient—within a foot or even closer. That every steam pipe nearest the floor may supply the greatest amount of heat it should have its own return to the main return of the system.

One inch pipe is generally used for such systems. No very definite data are available in regard to the amount neces-

sary to supply the requisite heat. Several kilns, however, which are said to work admirably, have about 650 running feet of pipe for every 100 square feet of floor space. One-half of this is "riser," the other half "return."

In the type of evaporator referred to as "cabinet evaporators," the length of one inch steam pipe required per square foot of surface directly exposed to the pipes is considerably less than in the case of the kiln just described, although it is probable that in the system in question a greater degree of heat can be maintained than with the usual piping for a kiln. As previously mentioned, in this system the pipes are arranged in horizontal tiers, the racks on which the fruit is placed being inserted between them. Hence, the upper racks receive more or less heat from the lower tiers, as well as from those to which they are directly exposed. In one evaporator of this type, which gives excellent satisfaction, and in which the drying compartments are about nine feet square—that is, large enough to hold four four-foot racks (two square) in the same plane—there are thirty-two one-inch pipes in each tier. Each pipe is about 8½ feet in length, or approximately 270 feet in each tier. In the evaporator referred to there are eight tiers in each compartment. Eight racks—two deep—are placed between each tier of pipes.

In another evaporator of this type, having a capacity of 400 bushels every twenty-four hours, a 40-horsepower boiler, with about 15 square feet of grate surface, furnishes the necessary steam when run at a pressure of 40 to 50 pounds This is sufficient for drying the fruit and for running the parers, slicers, elevators, etc., required to handle this quantity of fruit. The steam pressure at which such systems are run varies considerably according to the individual requirements of the systems. A range of from 40 to 90 pounds has been noted in different evaporators.

Fuel

Where the owner of an evaporator has an abundant supply of wood and it can be cut at times of leisure, this is probably the least expensive fuel in actual cash outlay that can be had in most of the apple-growing sections. In fact, under these conditions, it is commonly estimated that the fuel costs nothing. But in a great number of cases fuel has to be bought, even by operators who are drying apples from their own orchards.

For kiln evaporators using the common type of furnaces, hard coal is probably the most satisfactory fuel, and requires less attention than any other. Coke is sometimes used, and if it were as satisfactory as coal, other things being equal, it would be the cheaper fuel. But it requires much attention, and even with the best of care it is difficult to maintain a uniform degree of heat. A combination of coal and coke is sometimes used with satisfactory results, in which case the faults and advantages of one tend, in a measure, to equalize those of the other.

In a steam-heated plant soft coal serves the purpose in a satisfactory way, and in most apple-growing sections is probably cheaper than any other fuel that is readily available.

Quantity of Fuel Required

While the amount of fuel necessary to dry a given quantity of fruit will vary more or less, depending upon the conditions of the weather, the efficiency of the furnace, the construction of the kiln, the percentage of moisture to be left in the fruit, and various other things, it is roughly estimated that a ton of hard coal, for a kiln evaporator, will make a ton of dried fruit. Probably the average requirement is rather more than this. It is claimed that a tower evaporator requires slightly less for the same results. Open grates also considerably reduce the amount of fuel necessary for a given quantity of fruit, but on account of their objectionable features they can not be used for the better grades of apples. Coke is rather more efficient, 2,600 to 2,700 pounds of apples being evaporated, it is claimed, by a ton of fuel.

A good steam system should require considerably less than a ton of soft coal

to a ton of dried fruit, one estimate being about one-half this amount.

These estimates are for evaporating sliced fruit. If the apples are quartered or dried whole, being merely pared and cored, considerably more fuel is required. From 25 to 50 per cent more fuel should probably be estimated for in such cases.

Apples Suitable for Evaporation

There is an increasing demand for dried apples of the highest quality. The tendency has sometimes been to make quantity at the expense of quality. But prices are governed not only by the supply but also by the grade. The cleanest, whitest fruit, that is well cored, trimmed, bleached, ringed, and dried, is most in demand. Carelessness in any particular injures the product.

Primarily the economic usefulness of an apple evaporator is through its utilization of windfalls and the poorer grades of fruit which can not be marketed to good advantage in a fresh state, and it is these grades that are most often evaporated. But the magnitude of the crop also influences the grade of the evaporated product in a decided way. In seasons of abundant crops and low prices for fresh fruit large quantities of apples that would ordinarily be barreled are evaporated and the grade of stock produced is correspondingly improved. On the other hand, in years of scanty crops, when all apples that can possibly be shipped are in demand at high prices, only the very poorest fruit is evaporated, as a rule, thus lowering the grade of the output.

The commercial grading of evaporated apples is based primarily on appearance rather than on dessert quality, and the fact that one variety may make a better flavored product than another is not considered. As a rule, a product of high commercial grade can be made from any sort which has a firm texture and bleaches to a satisfactory degree of whiteness. A variety of high dessert quality, such as the Northern Spy, may be expected to make an evaporated product of correspondingly high flavor.

In sections where the Baldwin apple is grown extensively it is in demand at the commercial evaporators, as it meets the requirements in a fair degree and it is also available in relatively large quantities. In the Ben Davis sections that variety supplies a similar demand.

Most early varieties lack sufficient firmness of texture for the best results and are undesirable on this account. On the other hand, some comparatively early sorts, such as Gravenstein and Yellow Summer Pearmain, are considerably prized in some sections; the dessert quality of the latter is especially high.

Similarly the product made from other sorts possesses qualities that are due more or less to varietal characteristics. For instance, that from Esopus is said to be unusually white; Hubbardston and varieties of the Russet group also make very white stock. The latter make relatively a large amount of stock, by weight, to a given quantity of fresh fruit. Limbertwig is said to produce from one and one-half to two pounds a bushel more of dried stock than most sorts do, but it is not as white as that from some other varieties.

Preparing the Fruit for Drying

Paring

No special comments are necessary under the head of paring, save to mention this step in the order in which it occurs in the preparation of the apples for drying. The apples are cored in the same operation by an attachment applied to the paring machine for this purpose. The fruit is automatically forced from the fork and drops to the table, where it is next taken in hand by the trimmers. In the smaller evaporators the slicing is often done at the time of paring by a slicing attachment applied to the parers.

In nearly all the evaporators the paring and trimming are done by women and girls.

Trimming

In paring the fruit there is usually more or less skin left around the stem and calyx of the apples and any irregular places that may occur. There will be wormholes, decayed spots, and other blemishes which will detract from the appearance of the product, if allowed to remain.

Even bruises are objected to by the most exacting operators. Hence all such defects are cut out as soon as the fruit is pared if the highest grade of product is expected. This is done with an ordinary straight-back, sharp-pointed knife, having a blade two and one-half or three inches long.

Bleaching

The fumes of burning sulphur are employed not only to make the fruit white where the freshly cut surfaces have become discolored by contact with the air, but to prevent further discoloration after it is sliced. Sulphuring is also generally supposed to be necessary to destroy fungi and insects, though under present methods of handling this is open to question.

There are no definite standards governing the bleaching as to the time required, amount of sulphur necessary to accomplish the desired end, etc. The aim is to treat until enough of the fumes have been absorbed by the apples to prevent discoloration after they are sliced and exposed to the air. If it is found that the fruit is not retaining its clean, white appearance with the treatment that is being given, either the length of time that the fruit is kept in the bleacher is increased or more sulphur is burned in the customary time for bleaching. Due caution should be exercised, however, in this connection, inasmuch as the bleaching of desiccated fruits with sulphur fumes is open to criticism. The sale of fruit containing sulphurous acid in any considerable quantity is prohibited by the pure food laws of some states, as well as being restricted in some of the foreign markets. The Federal pure food law will also make definite restrictions.

In many cases the bleaching process is doubtless continued much longer than is necessary for the desired results. Until some definite standards are established and recognized, the greatest care should be exercised not to bleach more than the minimum required to maintain the desired color a reasonable length of time.

The allotted time for bleaching in a large number of evaporators, from which information has been secured, varies from twenty minutes to one and one-half hours. The more usual time appears to be about forty-five minutes. This, however, may be regulated in a measure by the amount of sulphur burned in a given time.

The estimates regarding the amount of sulphur used to bleach a ton of fruit vary from four or five pounds to 20 pounds, though but little information of a definite character is to be obtained at present.

The usual practice is to start the sulphur fumes by putting a few live coals into the receptacle used for the purpose, then adding a small piece or two of stick brimstone. Before this has all been vaporized, more is added. This is continued as long as the bleacher is in operation, sufficient heat being generated to vaporize the sulphur without the further addition of burning coals.

When apples are dried whole, without slicing or quartering, they require less bleaching than if they are to be sliced, inasmuch as the interior of the fruit does not come in contact with the air.

For the most satisfactory results it is essential that the fruit be put into the bleacher in the shortest possible time after the surface is exposed to the air by paring. If a long delay occurs the surface becomes discolored, in which case it does not regain its original whiteness in the bleaching process.

Slicing, Quartering, Etc.

After bleaching, the next step in preparing the fruit is slicing, unless instead of slicing it is quartered or dried whole, as is done to a limited extent. In preparing fruit for some of the smaller evaporators, as previously mentioned, the slicing is done when the fruit is pared, the bleaching then follows the slicing instead of preceding it.

The slices are one-fourth inch in thickness, and in the largest degree possible should be cut at right angles to the hole made through the axis of the apple when the core is removed by the parer, thus producing the "rings," which is the form most desired. Other things being equal that fruit is sliced the best which contains the largest proportion of "rings," and this point is given more or less weight in grading the finished product.

When it is desired to evaporate apples

in quarters or sixths they are run through machines which cut them accordingly, the cutting being done in the opposite direction from the slicing; that is, in a direction parallel to instead of at right angles to the axis of the apple.

If they are to be dried whole, they are transferred from the bleacher directly to the drying compartment without further treatment.

Drying the Fruit

When the fruit has been placed in the drying compartment of an evaporator, of whatever type it may be, it has reached the most critical stage in the whole process of evaporation, and it is here that the greatest care and skill are required to insure the best possible results.

Capacity of Floor Space and Racks

In the case of kiln evaporators, the sliced fruit is evenly spread on the floor to the depth of from four to six inches. A kiln 20 feet square will hold the slices of from 120 to 150 bushels of fresh fruit, depending upon the amount of waste in the apples and the exact depth to which they are spread on the floor.

If the fruit is in quarters or is dried whole, it may be somewhat thicker on the floor, since in these forms it does not pack down as closely as the slices do and hence does not impede the circulation of hot air through it if the depth is somewhat increased.

In tower evaporators and other types where the fruit is handled on racks the slices are seldom placed much more than one inch in depth. A rack four feet square will hold from three-fourths of a bushel to a bushel.

The fruit is generally put on the floor of the kiln as fast as it is sliced, and the fire is started in the furnace below as soon as the floor is filled, or, in many cases, before it is entirely covered.

Oiling the Floors and Racks

It is common practice to treat the floor of kilns occasionally with tallow to prevent the fruit from sticking to it. This is done every few days, or as often as conditions appear to make it advisable. Sometimes a mixture of equal parts of tallow and boiled linseed oil is used for this purpose.

Another practice, with the same end in view, is to thoroughly scrub the floors as often as is necessary with water, using with it some one of the scouring soaps. This is preferred by some operators, who claim that oil or tallow discolors the fruit.

At each filling of the racks, where these are used, the surface of the wire netting is lightly wiped over with a cloth moistened in lard. This prevents the fruit from sticking to the netting and keeps it clean.

Temperature Maintained

The temperature maintained in kilns or other drying compartments, in actual practice, is largely a matter of experience, not a factor governed by any definite standards or regulated in accordance with thermometer readings, as might be expected. In general, the object in view is to force the heat as high as possible without endangering the fruit. A probable temperature which has been suggested by some of the operators is 150 degrees Fahrenheit, or more when the fruit is first put into the drying compartment, dropping to about 125 degrees Fahrenheit as the drying process nears completion. Sufficient and proper provision for controlling the indraft of cold air below the fruit will aid in maintaining the desired temperature.

Turning the Fruit

In order to prevent the fruit from burning and from sticking to the floor by remaining in contact with it too long, and to insure the most uniform drying that is possible, the fruit, in the case of the kiln driers, is turned occasionally. The interval between turnings varies with different operators, with the condition of the fruit, and with the degree of heat which is maintained. Some operators do not turn the fruit until five hours have elapsed after the furnace has been started, while a more common practice is to make the first turning within two or three hours after the drying is begun, or even sooner. For the first five or six hours it is generally turned every two hours or so, and more frequently as the fruit becomes drier, until perhaps it may require turning every half hour when nearly dry.

The objects to be obtained by turning must be kept in mind and the fruit handled accordingly. It should be examined from time to time and turned often enough to prevent scorching or sticking and to insure uniform drying.

In the case of the tower evaporators and other types in which the fruit is handled on racks, no turning more than an occasional stirring of the fruit with the hand or with a small wooden paddle is required. Sometimes the relative positions of the racks are changed to make the drying more uniform. This is one reason why the tower-dried fruit is generally of rather better quality than that from kilns. The repeated turning on the kiln floor is likely to make the fruit more or less "mussy," while in that which remains practically undisturbed on the racks the rings are maintained in better condition. The fruit also dries more quickly, and is often of better color than the kiln-evaporated product, and hence is more attractive in appearance.

The same general principles must be observed in tending the fruit where steam heat is used in place of direct hot air from furnaces.

Time Required for Drying

The time necessary for drying fruit depends upon several factors. The more important are: Type of evaporator; depth to which fruit is spread; method of preparing—whether sliced, quartered, or whole; temperature maintained; conditions of the weather, and, to a certain extent, the construction of the evaporator.

The application of these several factors to the point in question readily follows. A good kiln evaporator should dry a floor of slices, other things being equal, in about twelve hours, ten to fourteen hours being the range of variation. Where the fruit is handled on racks the time required is much shorter, but conditions are quite different from the kilns, as the fruit is seldom more than one or two inches thick on the racks. For slices, five hours is considered a reasonable time, with a range of four to six hours.

It is estimated that quarters will require from eighteen to twenty-four hours in the average kiln, while the time for whole apples will range from thirty-six to forty-eight hours.

If the atmospheric conditions are heavy and damp, the drying is retarded. Under some conditions it is hardly possible to thoroughly dry the fruit. During windy weather also it is more difficult to regulate the heat, especially if the walls are poorly constructed so that the draft of cold air into the furnace room can not be controlled. This applies especially to kilns heated by furnaces. It is claimed that steam-heated evaporators are less subject to the influence of climatic conditions.

When Is the Fruit Dry?

Perhaps there is no step in the entire process that requires better trained judgment than the matter of determining when the fruit is sufficiently dried to meet the requirements. Like several other steps in the process it is largely a matter of experience, though there are certain general features which are capable of being reduced to words.

The fruit should be so dry that when a handful of slices is pressed together firmly into a ball the slices will be "springy" enough to separate at once upon being released from the hand. In this condition there will be no fruit, or only an occasional piece, that has any visible moisture on the surface. In a slice of average dryness, it should not be possible to press any free juice into view in a freshly made cross section of it. The general "feel" of the fruit, as it is handled, should be a soft, velvety, leathery texture.

The foregoing should represent as nearly as possible the average condition, but it cannot be expected to be absolutely uniform throughout. Some slices—they should constitute only a very small percentage—will still plainly possess some of the juice of the apple; others—likewise, properly only a small proportion—will be entirely too dry, possibly dry enough to be brittle.

The Curing Room

When a quantity of fruit is considered dry enough, it is removed from the kiln and put in a pile on the floor of the

curing room. Every day or two the pile should be thoroughly shoveled over to make uniform the changes which take place. Thus managed, the pile in a few days will become thoroughly homogeneous. The pieces that were too dry will have absorbed moisture, the superfluous moisture of other pieces will have disappeared, and the entire mass may be expected to reach the condition above described.

Handling the Waste

In the usual grades of apples that are taken to the evaporator there are many specimens that are too small to pare or which for other reasons can not be profitably used in this way. In the case of some of the larger evaporators which are operated in connection with vinegar factories, these apples, as well as all parings and trimmings, are used for "vinegar stock," but in the smaller ones these portions are usually dried. It is generally estimated that about one-third as much space is required to dry the parings and trimmings as is demanded for the "white fruit."

"Waste" and "chops" are generally bleached, but are seldom passed through the bleacher which is used for the white fruit Where they are dried in kilns, which is usually the case, a common way of bleaching is to burn the sulphur in the furnace room after the stock has been spread on the floor.

It is generally estimated that the waste from a given quantity of apples will pay the cost of the fuel for evaporating that quantity of fruit; that is, putting it on a bushel basis, the waste from a bushel will pay for fuel to evaporate both the white fruit and the waste from that bushel. While in some instances, when the price of such stock is low, this estimate may be too high, it not infrequently happens that it more than pays for the fuel.

Weight of Evaporated Apples

Some varieties of apples will make more evaporated stock to the bushel than others. The grade used also affects the amount, but an average weight—a frequent basis of estimates—is about 6½ pounds of white fruit and 3½ pounds of waste to a bushel of fresh fruit When the apples are dried whole, without slicing, they will make from one to two pounds more to the bushel than when sliced

Handling Evaporated Apples

While comparatively few of the manufacturers of evaporated apples pack their own fruit for the trade, it will be of interest to them and of direct value to know something of the methods pursued by dealers, and especially in regard to grading and the requirements of the various grades.

The product of all grades is generally shipped to the dealers in gunny sacks having a capacity of one and one-half to two bushels The "white fruit" is usually bought by the pound. Sometimes the waste is rated by the hundredweight. The price paid is not governed by the market conditions alone; the quality is an important factor.

Grading

In classifying evaporated apples, three grades are generally recognized which are commonly designated as "fancy," "choice," and "prime." Two other grades, which in reality are special grades, are also sometimes recognized, viz.: "extra fancy," and a lower grade than prime—usually called prime with some prefix, frequently the name of a locality, to distinguish it from that grade.

The standards demanded for these various grades are about as follows:

"Fancy" is very white, clean stock, free from all pieces of skin and other objectionable portions which should be removed in trimming, and a good portion of the slices in rings.

"Choice" denotes a grade intermediate between "fancy" and "prime," not quite clean enough for "fancy," yet more nearly free from imperfections than the "prime" grade demands.

"Prime" must be good stock, well cured, and of a generally attractive appearance. It must be comparatively white and mostly free from undesirable portions, but stock having a small percentage of such defects is usually put in this grade

"Extra fancy," as the name implies, is a fancy grade that is exceptionally fine. It must possess all the qualities mentioned

in describing that grade in a marked degree. At least 85 per cent of the slices should be "rings."

The grade below "prime" is the stock that has been so carelessly handled and is so unattractive in appearance that it cannot maintain the standard of "prime" It is packed for an entirely different and much poorer class of trade than any of the other grades.

Kinds of Packages Used

In packing the fruit, several sizes of packages are in common use. While the proportionate dimensions of the packages may vary with the different dealers and packers, their capacity is more or less a matter of uniform standards.

Perhaps the package most used is the 50-pound wooden box. A common form of this box is 10½ by 11 by 22 inches, inside measure. Twenty-five pound boxes are likewise much used; these are commonly made 9 by 9 by 18 inches, inside dimensions A box holding 55 pounds of sliced fruit, having inside measurements of 11 by 11¾ by 22½ inches, is much used for the export trade. These are generally marked "25 kilos" when intended for export, instead of having the capacity designated in pounds.

Pasteboard cartons, holding one pound, or one-half kilo (1.1 pounds) for certain export trade, are also more or less used for the better grades of sliced fruit. These cartons are generally packed in a box or case, 48 cartons to the case. The cartons are 2 by 5 by 7 inches; the case is about 12 by 16 by 21 inches.

All of these packages are used as desired for slices or "rings," but the quarters and whole fruit are generally packed in the 55-pound boxes, which, however, are expected to contain but 50 pounds of fruit in these forms.

Packing

The side of the box intended for the top or "face" is packed first, as in packing fresh fruit in boxes or barrels. The first step in packing, therefore, is to "face" this side The "facers" are slices which are perfect rings. These are usually selected from a quantity of fruit which contains a relatively large proportion of them; they are then placed on thin boards which are slightly smaller than the top of the box, inside measure, overlapping one another in rows, lengthwise of the board. The facers are put in place by inserting the board on which they are arranged into the box, which is first lined with paraffin paper, and then with a dexterous movement of the hand

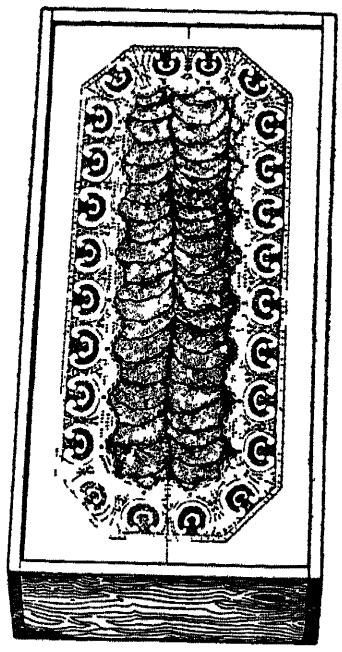

Fig 3. A 50 pound Box of "Fancy" Evaporated Apples with Cover Removed.

flipping the layer of rings against the inner face or the bottom, which is to become the top of the box.

A press is generally used in filling the boxes. Three men compose a packing gang for each press; one to fill the boxes and weigh the fruit; one to operate the press; a third to nail on the cover, which now becomes the bottom of the box.

In filling the boxes, an extension of the box upward is necessary, since 50 pounds of evaporated apples have to be compressed greatly in order to get them into a box of the required dimensions. This extension may be another box of same size with a rim nailed around the edge to fit over the box to be filled. The box is placed on a pair of scales and filled with the desired quantity of fruit, by weight; it is then passed to the press. A "follower" slightly smaller than the box is put in position over the fruit and this is pressed down until the fruit reaches the desired point.

Quarters and whole apples are handled in essentially the same manner except in regard to the facing. In facing whole ap-

ples they are placed on the side in rows lengthwise of the bottom (when packed, the top) of the box. The boxes are then filled the same as with slices. Quarters are handled in the same way.

Figure 3 is a box of fancy evaporated apples with cover removed, showing the paper lace used for decorative effect. Figure 4 is the same box with the paper covering entirely removed.

Cartons are filled by hand, the work usually being done on a table of convenient height. Each package is weighed to insure its proper content of fruit.

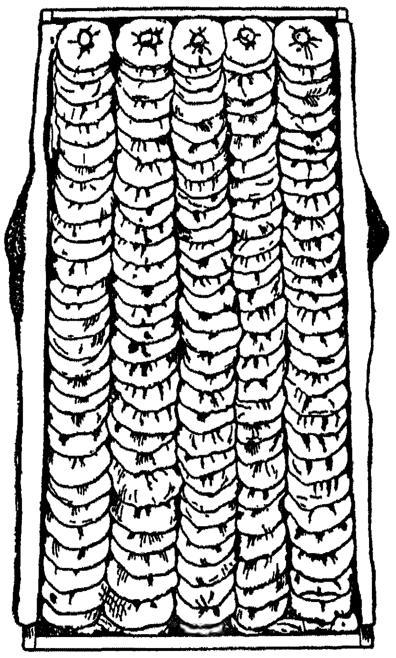

Fig. 4. A 50-pound Box of "Fancy" Evaporated Apples with Cover and Paper Lace Removed.

The sun-dried fruit, of which quite large quantities are handled by some dealers, is usually packed in sugar barrels. This is largely exported. The waste is also generally put into barrels, 240 to 250 pounds net usually filling a barrel. Chops are handled in a similar manner.

Storing the Fruit

In years of great abundance of apples, the evaporated product is likely to exceed the immediate demand. While fruit that has been well bleached and cured can be held for a considerable period of time without loss it is by no means imperishable. The color is first to deteriorate. The fruit appears to lose the effect of bleaching after a time and turns dark. Though it may retain its flavor for a long time, its unattractive appearance renders it more or less unsalable.

When it is desired to hold evaporated apples from one season to another, recourse is had to cold storage. Some seasons large quantities are handled in this way. The temperature at which it is stored is usually from 32 degrees to 35 degrees Fahrenheit, or about the same as for fresh fruit. If well bleached and properly cured it may be held for a relatively long period. Four or five years is said by commercial handlers to be about the usual limit of time before the color deteriorates. It is seldom, however, that it is desirable to hold the fruit for so long a time.

H. P. Gould,
Assistant Pomologist, Bureau of Plant Industry, Washington, D. C.

Condensed from Bureau of Plant Industry Bulletin 291.

Experiment Stations

Alabama—College Station, Auburn; J. F. Duggar*; Canebrake Station, Uniontown; L. H. Moore*; Tuskegee Station, Tuskegee Institute; G. W. Carver*.

Alaska—Sitka; C. C. Georgeson†.

Arizona—Tucson; R. H. Forbes.*

Arkansas—Fayetteville; M. Nelson*.

California—Berkeley; T. F. Hunt*.

Colorado—Fort Collins; C. P. Gillette*.

Connecticut—State Station, New Haven; Storrs Station, Storrs; E. H. Jenkins*.

Delaware—Newark; H. Hayward*.

Florida—Gainesville; P. H. Rolfs*.

Georgia—Experiment, R. J. H. DeLoach*.

Guam—Island of Guam; J. B. Thompson†.

Hawaii—Federal Station, Honolulu; E. V. Wilcox†. Sugar Planters Station, Honolulu; H. P. Agee*.

Idaho—Moscow; W. L. Carlyle*.

Illinois—Urbana; E. Davenport*.

Indiana—La Fayette; A. Goss*.

Iowa—Ames; C. F. Curtiss*.

Kansas—Manhattan; W. M. Jardine*.

Kentucky—Lexington; J. H. Kastle*.

Louisiana — State Station, Baton Rouge; Sugar Station, Audubon Park, New Orleans; North Louisiana Station, Calhoun; W. R. Dodson*.

Maine—Orono; C. D. Woods*.

Maryland—College Park; H. J. Patterson*.

Massachusetts—Amherst; W. P. Brooks*.

Michigan—East Lansing; R. S. Shaw*.

Minnesota—University Farm, St. Paul; A. F. Woods*.

Mississippi—Agricultural College; E. R. Lloyd*.

Missouri—College Station, Columbia; F. B. Mumford*. Fruit Station, Mountain Grove; Paul Evans*.

Montana—Bozeman; F. B. Linfield*.

Nebraska—Lincoln; E. A. Burnett*.

Nevada—Reno; S. B. Doten*.

New Hampshire—Durham; J. C. Kendall*.

New Jersey—New Brunswick; J. G. Lipman*.

New Mexico—State College; Fabian Garcia*.

New York—State Station, Geneva; W. H. Jordan*. Cornell Station, Ithaca; W. A. Stocking, Jr.‡

North Carolina—College Station, West Raleigh; State Station, Raleigh; B. W. Kilgore*.

North Dakota—Agricultural College, T. P. Cooper*.

Ohio—Wooster; C. E. Thorne*.

Oklahoma—Stillwater; L. L. Lewis*.

Oregon—Corvallis; J. Withycombe*.

Pennsylvania—State College; R. L. Watts*. State College, Institute of Animal Nutrition; H. P. Armsby*.

Porto Rico—Federal Station, Mayaguez; D. W. May†. Sugar Planters, Station, Rio Piedras; J. T. Crawley*.

Rhode Island—Kingston; B. L. Hartwell*.

South Carolina—Clemson College; J. N. Harper*.

South Dakota—Brookings; J. W. Wilson*.

Tennessee—Knoxville; H. A. Morgan*.

Texas—College Station; B. Youngblood*.

Utah—Logan; E. D. Ball*.

Vermont—Burlington; J. L. Hills*.

Virginia—Blacksburg; S. W. Fletcher*. Norfolk, Truck Station; T. C. Johnson*.

Washington—Pullman; I. D. Cardiff*.

West Virginia — Morgantown; E. D. Sanderson*.

Wisconsin—Madison; H. L. Russell*.

Wyoming—Laramie; H. G. Knight*.

* Director.
† Special agent in charge.
‡ Acting director.

EXPOSURE. See *Apple Orchard, Selecting a Site For.*

EVAPORATION OF WATER. See *Irrigation.*

Farms

*Farm Value of Important Crops

(Average prices paid to producers in the United States.)

PRODUCT	Feb. 15, 1912	Jan. 15, 1912	Dec. 15, 1911	Nov. 15, 1911	Oct. 15, 1911	Feb. 15, 1911
Apples, per bu	$ 0.98	$ 0.93	$ 0.86	$ 0.73	$ 0.66	$ 1.19
Pears, per bu	....	....	1.11	.85	.97	....
Beans, per bu	2.38	2.38	2.42	2.34	2.27	2.23
Onions, per bu	1.40	1.17	1.13	1.03	1.02	1.04
Cabbage, per 100 lbs	2.24	1.89	1.83	1.51	1.58	1.48
Sweet Potatoes, per bu	.94	.87	.79	.76	.86	.82
Clover Seed, per bu	12.22	10.89	10.62	10.37	10.33	8.37
Timothy Seed, per bu	7.26	6.99	6.72	6.90	6.91	4.51
Cotton Seed, per ton	16.81	16.57	16.70	16.69	16.73	25.61
Horses, per head	137.00	134.00	134.00	136.00	137.00	144.00
Beef Cattle, per 100 lbs	4.61	4.46	4.37	4.36	4.32	4.57
Veal Calves, per 100 lbs	6.07	6.06	5.98	6.10	6.15	6.38
Milch Cows, per head	43.40	42.89	42.72	42.70	42.69	44.98
Sheep, per 100 lbs	4.01	3.89	3.71	3.65	3.68	4.34
Lambs, per 100 lbs	5.15	5.22	4.93	4.68	4.68	5.44
Hogs, per 100 lbs	5.79	5.74	5.72	5.86	6.09	6.93
Milk, per gallon	.232	.228	.222	.218	.213	.221
Wool, unwashed, per lb	.163	.162	.155	.156	.155	.173
Honey, comb, per lb	.140	.138	.138	.136	.137	.133
Bran†, per ton	28.62	27.39	26.99	20.72	....	25.27

† Price to Feeders.

* From Crop Reporter, March, 1912.

* Farm Wages

The average wages of farm labor in the United States, as reported by correspondents of the Bureau of Statistics, Department of Agriculture, for years indicated, was as follows:

Year ending June 30, 1911.

YEAR	Wages of Farm Labor, when employed by—					
	Month		Day, at harvest		Day, other than harvest	
	Without Board	With Board	Without Board	With Board	Without Board	With Board
1911	$28.77	$20.18	$1.85	$1.49	$1.42	$1.09
1910	27.50	19.21	1.82	1.45	1.38	1.06
1902	22.14	16.40	1.53	1.34	1.13	.89
1899	20.23	14.07	1.37	1.12	1.01	.77
1898	19.38	13.43	1.30	1.05	.96	.72
1895	17.69	12.02	1.14	.92	.81	.62
1894	17.74	12.16	1.13	.93	.81	.63
1893	19.10	13.29	1.24	1.03	.89	.69
1892	18.60	12.54	1.30	1.02	.92	.67
1890	18.33	12.45	1.30	1.02	.92	.68
1888	18.24	12.36	1.31	1.02	.92	.67
1885	17.97	12.34	1.40	1.10	.91	.67
1882	18.94	12.41	1.48	1.15	.93	.67
1879	16.42	10.43	1.30	1.00	.81	.59
1875†	19.87	12.72	1.70	1.35	1.08	.78
1869†	25.92	16.55	2.20	1.74	1.41	1.02
1866†	26.87	17.45	2.20	1.74	1.49	1.08

† In currency.

* From Crop Reporter, March, 1912.

KEEPING OUR CHILDREN ON THE FARM

There is only one way known to the writer to keep children on the farm, after they reach their majority, and that is to make the farm attractive. In order to make it attractive, it must be made financially profitable, and socially pleasant. How to make the farm as profitable as other lines of business, is the problem. In order to be made profitable, its products must yield as much money, for a given amount of labor, as other lines of business. If the farm can be made to supply these needs, our young people will not desire to leave it, but if it cannot, they will continue to crowd into the cities for the purpose of making money, and obtaining social privileges they cannot obtain in the country.

The days of social isolation are practically past, except for a limited number of persons, who care little for education, entertainment, and the gratification of the social instincts. The farmer generally tries to educate his family. Even though he has not the advantages in the sparsely settled districts he sends his children to high school, and often to college, during which period they come into contact with the world in a broader way than ever before, and develop some kind of social life not possible on the farm. Education has created wants and if the farm will not furnish the means and opportunities to supply them, the best educated of our young people will leave the farm.

It is a fact that with the present status of our industrial development, the farm does not produce enough to supply the wants of an educated citizenship. Statistics show that the average farm, in the United States, yields less in net profits than the average wage worker receives. Yet the average farm requires an

investment of over $6,000 for land, stock and farm machinery. So long as it is true that the average wage worker, with no investment at all, can live in town and receive for his year's labor as much as the average farmer receives with his $6,000 investment, it will be impossible to keep our best, most educated and spirited young people on the farm.

The tendency has been to build up our manufacturing, mining, and commercial industries by bonuses, subsidies, tariffs, land grants and other devices, disproportionately when compared to the importance and extent of the wealth produced and the number of persons employed on farms. The tendency is now to give more attention to the farm, to educate the farmer as to the best methods of production, to show how larger crops can be produced for a given amount of labor, and how greater profits may be obtained without raising the cost to consumers.

It is a fact that work on the farm is conducted with less system, and less scientific analysis of all the factors involved, than most other lines of business. Comparatively few farmers keep anything like correct book accounts of the expenses and income of the various departments of farm work. Few have any idea as to the best methods of soil conservation for the various kinds of crops, and how to leave to their children land as rich or richer than they found it, and fewer still seem to recognize the value of a proper cultivation of social life.

The isolation of farm life is being, in part, overcome by the use of automobiles which, on account of the rapid travel, seems to shorten the distances between places. But the ownership of automobiles implies more than average conditions on the part of the owners. It implies an additional expenditure for good roads. This means that the farm must be made sufficiently profitable to pay for all these expenses.

Generally a fruit growing district yields more wealth, in proportion to a given area, than a country devoted to other kinds of production. It would probably be easier therefore for fruit growers to live on smaller tracts of land, live in closer relations to each other, have better roads, more modern improvements and better social life than farmers in general; but it is nevertheless a question largely of financial profit, which must be worked out in a more scientific way than formerly.

GRANVILLE LOWTHER

MINOR ARTICLES OF FARM EQUIPMENT

Few farmers realize the extent of their investment in small items of equipment or the time and inconvenience involved in buying numerous articles singly or in small lots. Before planning the farm equipment, due consideration should be given to the necessary outlay for minor items, and where possible the latter should be secured at one purchase, thereby saving time and, usually, money. The purchase of these articles in such a manner will mean a total expenditure sufficient to impress the farmer with the need for their systematic care. The minor items for a general farm of 160 acres in the Middle Western states will probably cost from $200 to $300.

The lists given below are in the nature of a census in that they present data from which each individual may secure the information suited to his own use. These lists are printed with that object in view rather than as a recommendation of what should be purchased. Farmers' Bulletin 347, following a discussion of the various workshop tools, states that the complete equipment of a shop for the making of general farm repairs should include a blacksmithing outfit, a $25 collection of wood working and general purpose tools, a pipe working combination, miscellaneous tools, a harness repair outfit, a work bench, a pair of saw horses, and a grindstone, and that this entire equipment for a shop can be secured for about $100 in a fair quality of goods, while for $150 tools of excellent quality can be obtained.

The great number of general purpose items, other than those mentioned, together with those for use in connection with the producing enterprises, and the stock of materials needed for the repair

of farm equipment will easily bring the total cost of a good working equipment in miscellaneous articles up to $250. The expenditure of this sum for this purpose in the organization of the farm is probably out of the question for many farmers, but due consideration at the outset for the necessary investment in minor items will save much inconvenience and disappointment later.

Table I

Summary of items of minor equipment, with the number and cost of all items suggested as necessary and their total cost.

	1	2	3	4	5
ITEMS	Percentage of farms reporting	Average number of items per farm reporting	Number of each item suggested as necessary	Cost of each item	Total cost of items suggested as necessary
General purpose:					
Auger	67	3.0	3	$0.25	$0.75
Awl	27	1.9	1	.10	.10
Ax and handle	88	2.1	2	1.25	2.50
Pinch bar	64	1.1	1	.75	.75
Bench screw	55	1.0	1	.60	.60
Auger bit	94	6.7	7	.30	2.00
Bit brace	94	1.2	1	1.50	1.50
Steel square	85	1.1	1	.75	.75
Bevel square	35	1.0	1	.40	.40
Try-square	25	1.0	1	.25	.25
Wood chisel	73	4.3	4	.40	1.50
Compass	42	1.0	1	.30	.30
Level	64	1.2	1	.75	.75
Drawing knife	91	1.3	1	.75	.75
Scratch gauge	45	1.4	1	.40	.40
Gimlet bits	55	3.0	2	.20	.40
Grub hoe	21	1.1	....	.50	....
Claw hammer	82	1.3	1	.50	.50
Hand ax	36	1.0	1	.50	.50
Hatchet	70	1.4	1	.75	.75
Screw-driver	67	1.7	1	.25	.25
Log chain	82	2.5	2	1.50	3.00
Wooden mallet	36	1.5	1	.25	.25
Mattock	79	1.4	1	.75	.75
Compass saw	42	1.0	1	.30	.30
Handsaw	94	1.7	2	1.25	2.50
Crosscut saw, large	85	1.2	1	3.00	3.00
Plane	73	2.3	2	1.25	2.50
Iron wedge	79	2.5	2	.30	.60
Tapeline	39	1.1	1	.50	.50
Rasp	39	1.1	1	.50	.50
Brush hook or scythe	21	1.0	....	1.25	....
Cant hook	42	1.4	1	1.25	1.25
Chalk line	27	1.0	1	.10	.10
Buck saw	10	1.0	....	.75	....
Carpenter's pincers	30	1.2	1	.60	.60
Anvil	21	1.0	....	10.00	....
Vise	15	1.2	....	5.50	....
Forge	3	1.0	....	16.00	....
Combination drill press	23	1.0	1	4.00	4.00
Drills	27	3.9	4	.50	2.00
Tinner's snips	18	1.0	....	1.25	....
Cold chisel	73	2.3	2	.20	.40
Whetstone	24	1.8	1	.10	.10
Screw plate	27	1.0	1	10.00	10.00
Tongs	6	2.0	....	.50	....
Flat file	70	2.0	2	.15	.30
Round file	35	1.5	1	.30	.30
Taper file	42	2.2	2	.10	.20
Oil can	30	1.7	1	.10	.10
Machine oil	61	* .8	*1	.30	.30
Pipe wrench	24	1.3	1	1.50	1.50
Monkey wrench	64	2.1	2	.50	1.00
Tool grinder	30	1.0	1	3.00	3.00
Grindstone	91	1.0	1	4.00	4.00
Riveting hammer	39	1.5	1	.75	.75
Sledge hammer	33	1.1	1	1.00	1.00
Pliers	67	1.4	1	.50	.50
Nippers	52	1.5	1	1.00	1.00

*Gallons.

Table I—Continued

Summary of items of minor equipment, with the number and cost of all items suggested as necessary and their total cost.

ITEMS	1 Percentage of farms reporting	2 Average number of items per farm reporting	3 Number of each item suggested as necessary	4 Cost of each item	5 Total cost of items suggested as necessary
General purpose—Continued:					
Punch	33	2.2	2	$ .15	$ .30
Hack saw	18	1.0	....	.50	....
Saw-set	36	1.0	1	.60	.60
Maul	16	1.0	....	.60	....
Post-hole digger	41	1.5	1	1.25	1.25
Wire splicer	11	1.3	....	1.00	....
Wire stretcher	29	1.1	1	1.00	1.00
Ditch cleaner	22	1.0	1	1.25	1.25
Tile spade	31	1.6	1	1.00	1.00
Brick trowel	44	1.4	1	.40	.40
Plastering trowel	6	1.0	....	1.00	....
Sand sieve	16	1.4	....	.50	....
Pick	31	1.9	1	1.00	1.00
D-handled shovel	31	1.4	1	1.00	1.00
Long-handled shovel	13	1.3	....	1.00	....
Counter scale	16	1.0	....	5.00	....
Spring balance	34	1.1	1	.50	.50
Steelyards	28	1.1	1	2.00	2.00
Platform scale	38	1.0	1	8.00	8.00
Rat trap	24	1.0	1	.50	.50
Steel trap	26	2.1	1	.15	.15
Jackscrew	3	5.0	....	2.00	....
Stepladders	45	1.4	1	1.75	1.75
Ladder	52	1.4	1	2.00	2.00
Farm bell	58	1.0	1	2.00	2.00
Lantern	68	1.8	2	.90	1.80
Hoisting block	16	1.2	....	2.00	....
Barrel	71	3.0	3	.75	2.25
Padlock	39	1.8	1	.40	.40
Paint brush	48	3.3	2	.30	.60
Whitewash brush	26	1.4	1	.75	.75
Basket	52	5.8	4	.30	1.20
Household and farm:					
Lard press and sausage stuffer	45	1.0	1	5.50	5.50
Sausage grinder	48	1.0	1	2.00	2.00
Hog scraper	10	2.8	2	.10	.20
Hog hook	29	1.1	1	.05	.05
Butcher knife	52	2.4	2	.30	.60
Kettle	55	1.7	1	2.50	2.50
Tree pruner	15	1.2	....	1.50	....
Pruning shears	39	1.3	1	.40	.40
Crates	39	54.7	40	.40	16.00
Garden rake	64	1.2	1	.50	.50
Hoe	88	2.4	2	.40	.80
Cultivator	12	1.3	....	4.00	....
Trowel	12	1.3	....	.25	....
Cold frame	3	8.0	....	2.50	....
Flat	3	3.0	....	.10	....
Spade	36	1.4	1	.75	.75
Sprinkler	21	1.1	....	.50	....
Lawn mower	64	1.0	1	4.00	4.00
Lawn rake	21	1.0	....	.40	....
All stock:					
Broom	9	2.0	....	.30	....
Clipping machine	15	1.0	....	6.00	....
Manure fork	42	2.6	2	.70	1.40
Pail	27	4.4	3	.15	.45
Tie chain	18	5.3	3	.25	.75
Tie rope	9	2.3	....	.25	....
Hand sprayer	12	1.0	....	.75	....
Wheelbarrow	42	1.4	1	4.00	4.00
Horse and driving:					
Bit	40	2.4	2	.40	.80
Blanket	91	2.8	3	2.00	6.00
Brush	89	2.0	2	.50	1.00
Currycomb	89	2.3	2	.25	.50
Collar	43	2.7	2	3.00	6.00

Table I—Continued

Summary of items of minor equipment, with the number and cost of all items suggested as necessary and their total cost.

ITEMS	1 Percentage of farms reporting	2 Average number of items per farm reporting	3 Number of each item suggested as necessary	4 Cost of each item	5 Total cost of items suggested as necessary
Horse and driving—Continued:					
Harness oil	34	‡1.5	‡2	$ .25	$ .50
Fly nets	34	2.8	2	1.00	2.00
Halters	97	6.5	6	.75	4.50
Muzzle	26	1.8	2	.20	.40
Nosebag	14	1.4	....	.50	....
Sweat pad	37	2.2	2	.35	.70
Harness punch	69	1.2	1	.50	.50
Riveting machine	69	1.0	1	.50	.50
Rivets	43	†1.2	†1	.10	.10
Tie rope	31	2.8	2	.15	.30
Saddle	57	1.0	1	10.00	10.00
Riding bridle	23	1.3	1	1.00	1.00
Snaps	23	7.4	4	.05	.20
Sponge	14	2.0	1	.10	.10
Neck straps	43	1.9	1	.75	.75
Syringe	23	1.1	1	.60	.60
Storm apron	17	1.2	1	.75	.75
Buggy jack	40	1.1	1	.75	.75
Wagon jack	14	1.0	....	1.00	....
Clevis	40	4.3	3	.10	.30
Chamois skin	11	1.0	....	.50	....
Dust robe	62	1.2	1	1.00	1.00
Lap robe	71	1.6	1	5.00	5.00
Evener, 2-horse	60	2.0	2	1.50	3.00
Evener, 3 or 4-horse	63	1.5	1	2.00	2.00
Storm front	46	1.1	1	4.00	4.00
Dash lantern	23	1.4	1	1.00	1.00
Neck yoke	14	1.6	1	1.00	1.00
Whippletree	29	3.1	2	.30	.60
Whip	60	1.4	1	.50	.50
Whisk broom	11	1.0	....	.10	....
Cattle:					
Cow bell	6	1.5	....	.25	....
Calf muzzle	3	1.0	....	.20	....
Crate	3	1.0	....	.50	....
Tie rope or chain	39	3.9	3	.30	.90
Dehorning clipper	9	1.0	....	5.00	....
Milk tube	15	1.0	....	.25	....
Dairy:					
Milk can	36	4.9	4	1.50	6.00
Milk crock	27	9.9	7	.10	.70
Milk pan	6	5.0	....	.20	....
Milk pail	70	3.2	3	.50	1.50
Churn	45	1.1	1	4.00	4.00
Butter crock	21	10.1	6	.20	1.20
Butter bowl	21	1.0	....	.50	....
Butter scales	6	1.0	....	1.50	....
Strainer	30	1.0	1	.50	.50
Skimmer	6	1.0	....	.10	....
Thermometer	24	1.0	1	.25	.25
Sheep:					
Bell	12	5.0	3	.15	.45
Shears	48	1.6	1	1.00	1.00
Swine:					
Ring plier	58	1.1	1	.20	.20
Rings	....	....	†1	.10	.10
Snout clipper	3	1.0	....	.40	....
Tongs	3	1.0	....	.50	....
Crate	15	2.0	....	1.00	....
Portable house	39	6.6	5	4.00	20.00
Poultry:					
Fountain	6	3.5	....	.25	....
Feed hopper	3	3.0	....	.25	....
Trap nests	3	8.0	....	.25	....
Feed pan	3	6.0	....	.05	....
Feed sieve	3	1.0	....	.25	....

‡Quarts. †Boxes.

Table I—Concluded

Summary of items of minor equipment, with the number and cost of all items suggested as necessary and their total cost.

ITEMS	1 Percentage of farms reporting	2 Average number of items per farm reporting	3 Number of each item suggested as necessary	4 Cost of each item	5 Total cost of items suggested as necessary
Poultry—Continued:					
Hover box	3	6.0		$ .25	
Egg tester	6	1.0		.15	
Coop	3	3.0		3.00	
Leg bands	6	50.5			
Bone cutter	6	1.0		6.00	
Bees:					
Foundation	6	•6.0		.75	
Section box (100)	12	2.8		.75	
Foundation fastener	9	1.0		.75	
Hive	15	19.6		1.00	
Super	12	30.3		.50	
Smoker	12	1.0		1.00	
Bee escape	6	2.0		.25	
Bee veil	9	1.3		.10	
Honey crate	6	13.5		.25	
Honey extractor	6	1.0		3.50	
Corn:					
Shock tier	27	1.0	1	.50	$ .50
Knife	70	2.7	2	.25	.50
Hand planter	61	1.3	1	1.50	1.50
Ensilage fork	6	1.0		1.00	
Seed tester	42	1.5	1	.50	.50
Seed rack	9	1.3		1.00	
Husking peg	30	2.9	2	.10	.20
Husking gloves	12	⊕1.3		.75	
Hay:					
Stack cover	3	2.0		8.00	
Carrier	30	1.1	1	3.00	3.00
Hoisting fork	58	1.1	1	1.25	1.25
Pulleys	55	4.5	4	.40	1.60
Hay rope, 1-inch	61	x132.5	•110		5.00
Trip rope, ½-inch	30	x 65.0	• 40		.45
Hand fork	88	3.2	3	.60	1.80
Baled hay hook	21	1.6	1	.30	.30
Scythe and snath	88	1.4	1	1.25	1.25
Hand seeder	70	1.1	1	5.00	5.00
Sickle	32	1.1	1	.50	.50
Slings	9	2.7		2.00	
Knife	67	1.2	1	.75	.75
Small grain and seed:					
Cradle	48	1.0	1	5.00	5.00
Binder cover	36	1.0	1	3.00	3.00
Flail	15	1.6			
Measure	33	1.4	1	.50	.50
Straw fork	15	1.2		.70	
Hand rake	36	1.3	1	.25	.25
Sacks	97	38.6	38	.20	7.60
Scoop shovel	82	1.7	2	1.00	2.00
Sugar beets:					
Beet fork	3	2.0		1.50	
Beet hoe	3	6.0		.50	
Beet topper	3	9.0		.25	
Potatoes:					
Scoop	3	1.0		1.50	
Fork or hook	39	1.4	1	1.50	1.50
Hand planter	3	1.0		1.75	
Maple sugar:					
Sap bucket	21	471.0		.20	
Spout	15	485.0		.03	
Cover	3	500.0		.06	
Scoop	12	1.0		1.00	
Gathering pail	12	2.5		.75	
Tapping bit	9	2.0		.30	
Total cost of items suggested as necessary					$270.70

xFeet. •Pounds. ⊕Pairs.

WATER SUPPLY FOR THE FARM HOME

The failure to employ modern methods of lightening labor inside the house is a great hardship on many farms. Thoughtfully planned, conveniently arranged, and carefully constructed buildings are as essential in the country as in the city. Plumbing is becoming a necessity, not only for comfort and convenience but even more for health and cleanliness; and the proper disposal of the wastes of the household should not be neglected.

For domestic purposes the water must be clear, pure, and palatable; the essentials being freedom from disease germs, turbidity, color, odor and taste.

Springs and Wells

Of the various sources of supply springs usually rank first and deep wells next in desirability. The character of the water in a shallow well depends upon its past history and present environment. If it has traveled long distances through the soil without encountering organic impurities or taking up objectionable mineral salts, or if after possible pollution it has been filtered and purified in its travels, its quality is probably excellent. But shallow wells near barnyards or privy vaults should always be regarded with suspicion. It is well to remember that the price of pure water, wherever you go, is everlasting and unremitting vigilance.

To locate a cesspool and a well on the same small piece of ground is almost impossible without contaminating the water. Slop water of any kind should never be thrown near the well. The top 4 or 5 feet of the well casing should be laid in cement mortar to prevent water flowing in without first filtering through the ground. A sewer pipe or waste drain near a well is dangerous because such a pipe or drain is seldom watertight. If a sewer pipe must be run near a well, cast iron pipe should be used.

The carelessness that will locate the barn on higher ground than the well and take no precautions to divert the surface drainage is almost as deplorable as the use of the cesspool or privy vault To keep the earth clean in the vicinity of the water supply is of the greatest importance and requires constant watchfulness.

Water Storage

Cisterns

There are localities where the only available water supply is obtained by storing the water which falls from the roof of the house during rainy weather. In other places the water is so hard that rain water is desirable in the laundry and bathroom.

Construction

The size of the cistern needed will vary with the size of the family, the length of the dry season, and the number of plumbing fixtures supplied with the rain water. This cistern may be located close to the house for convenience and should be added by building an 8-inch wall not less than 8 inches in thickness, laid in Portland cement mortar. The bottom should be laid with two courses of brick well bedded in the cement mortar. If the water is to be used for drinking or for cooking, a filter chamber should be added by building an 8-inch partition wall after the bottom has been paved. This wall should be built a little higher than the outlet of the overflow pipe. The walls of both compartments should be plastered with a good coat of cement mortar, composed of one part good Portland cement and two parts clean, sharp sand, excepting 10 or 12 inches of the bottom of the partition wall (4 or 5 courses of brick, which are laid together without cement) for the water to pass through. The water from the roof is collected in one compartment and is pumped from the other, the filtering material being put in the first compartment. An overflow pipe should be provided on the side of the cistern which the water enters, the opening of the overflow pipe being fitted with a fine strainer to exclude insects or vermin. A cutoff should be placed on the rain water pipe leading to the cistern to divert the flow to the outside when necessary, as, for instance, for a short time at the beginning of the rains to exclude the dirt collected on the roof and in the gutters.

The cistern may be built of concrete, and may be either round or rectangular. The round form is the more difficult to build, but it is the stronger.

Use of a Pump

A small force pump, placed at one end of the kitchen sink, with the suction pipe reaching to the cistern, is a convenient means of getting the soft water supply if the more expensive method of using a gravity tank or a pneumatic tank and piping the soft water to the sink, wash basins, and bath tub is not desired. If a gravity soft water tank is placed in the attic it can have a direct connection with a rain water leader which will keep the tank full during the rainy season. This conection must be supplied with an automatic cut-off which will send the water to the cistern when the attic tank is full. The force pump can be connected to the tank and used to fill it in dry seasons.

To have a constant water supply in the kitchen and bathroom it is necessary to have some means of storing it under pressure. An elevated tank which will deliver the water by gravity may be used, or a pneumatic tank which will deliver it by air pressure. The labor saved by having the water carried to the house, barn and garden, will soon pay for the storage tank, while the value of adequate fire protection and the healthfulness of sanitary plumbing can not be estimated in dollars.

Elevated Tanks

Location of the Tank

If the gravity system is chosen, the tank for the storage of the water may be in the attic or on an outside tower. If a windmill is used for power, a small tank can be supported 20 to 40 feet from the ground, on the same tower. These tanks can be constructed of wood or of galvanized steel, and of capacity varying from 300 to 2,000 gallons. If a larger tank is desired, a tank on an independent tower should generally be used with pipe connections to house and barns. When the storage for the house supply is in the attic, too large a tank should not be used, as water is heavy (62.5 pounds per cubic foot) and there is danger of overloading the attic floor unless it has been especially designed to carry the tank.

Kinds, Construction and Cost

Attic tanks are constructed of wood lined with zinc or lead, of galvanized steel, of cast iron, and of wrought iron. Such tanks should always be provided with an overflow pipe to carry off the water if the float valve fails to shut it off when the tank is full. If of iron or steel, a galvanized steel tank pan with a drain connecting with the overflow pipe should be placed beneath the tank to prevent damage to floors and ceilings from condensation of moisture on the outside. The water supply is regulated by means of a float valve which cuts off the inlet pipe when the tank is full enough. The size of the tank will be regulated by the power used to raise the water as well as the amount required by the family. The hydraulic ram or the windmill will require only a small storage tank, as they are so easily set going. If an engine is used, a tank that will hold a two or three days' supply would be more convenient and economical. A closed steel tank, fitted with a water seal air valve, may be used in the attic with the overflow pipe leading to the stock tank in the barnyard. This insures a constant renewal of the water. There is one farm in Illinois where the water supply is forced to an attic tank and the fall of the surplus operates a water motor for lifting the cistern water to another tank in the attic, and then the surplus water goes to a tank in the hay mow of the barn with an overflow pipe to a stock tank in the barnyard. This illustrates how well the head can be made to save the heels.

If all the plumbing fixtures are on the ground floor, the closed steel tank for the cold water supply can be placed in the kitchen or bathroom. If desired, the entire water supply can be made to pass through this house tank and so the house supply will be always fresh. With a closed tank there is no danger from overflow.

A tank like this, 12 inches in diameter and four feet high, will hold 24 gallons and cost about $16. An open galvanized steel tank can be made or can be bought ready made. A ready made one with a capacity of 100 gallons will cost about $8, while a 500-gallon tank will cost about $16.

Pneumatic Tanks

Sufficient pressure to force a water supply wherever desired in a farmhouse may be secured at all seasons by means of a pneumatic tank built of steel plates and located in the cellar, or in a small building erected over the well, or even buried in the earth if desired. It is superior to an elevated tank because the pipes and tank can more easily be made frost proof in winter and the water will be cooler in summer. It is closed to dust and light and has the additional advantage of resting upon the solid ground.

Principle of Action

Water is pumped into the bottom of this air-tight tank, and as the water rises in the tank the air above it is compressed. The expansion of this compressed air will force the water through the supply pipes at the bottom of the tank to points where the water is required. The pressure is increased by pumping more water into the tank and decreased by drawing water off. A 15-pound pressure will raise water to a height of 33 feet, a 10-pound pressure to a height of 22 feet, etc. The correct amount of air can be supplied and maintained by an automatic air valve, by a pump that forces both air and water into the tank at the same time, or by a hand air-valve. The last method is not self-regulating, but if water is supplied to the tank by a hand force pump, it will not require much more attention to regulate the air pressure also.

Power; Cost

The water can be forced into the pneumatic tank by the same means required to elevate it to a gravity tank, i. e., by a windmill, gas engine, hot-air engine, hydraulic ram, or by hand. From ten to

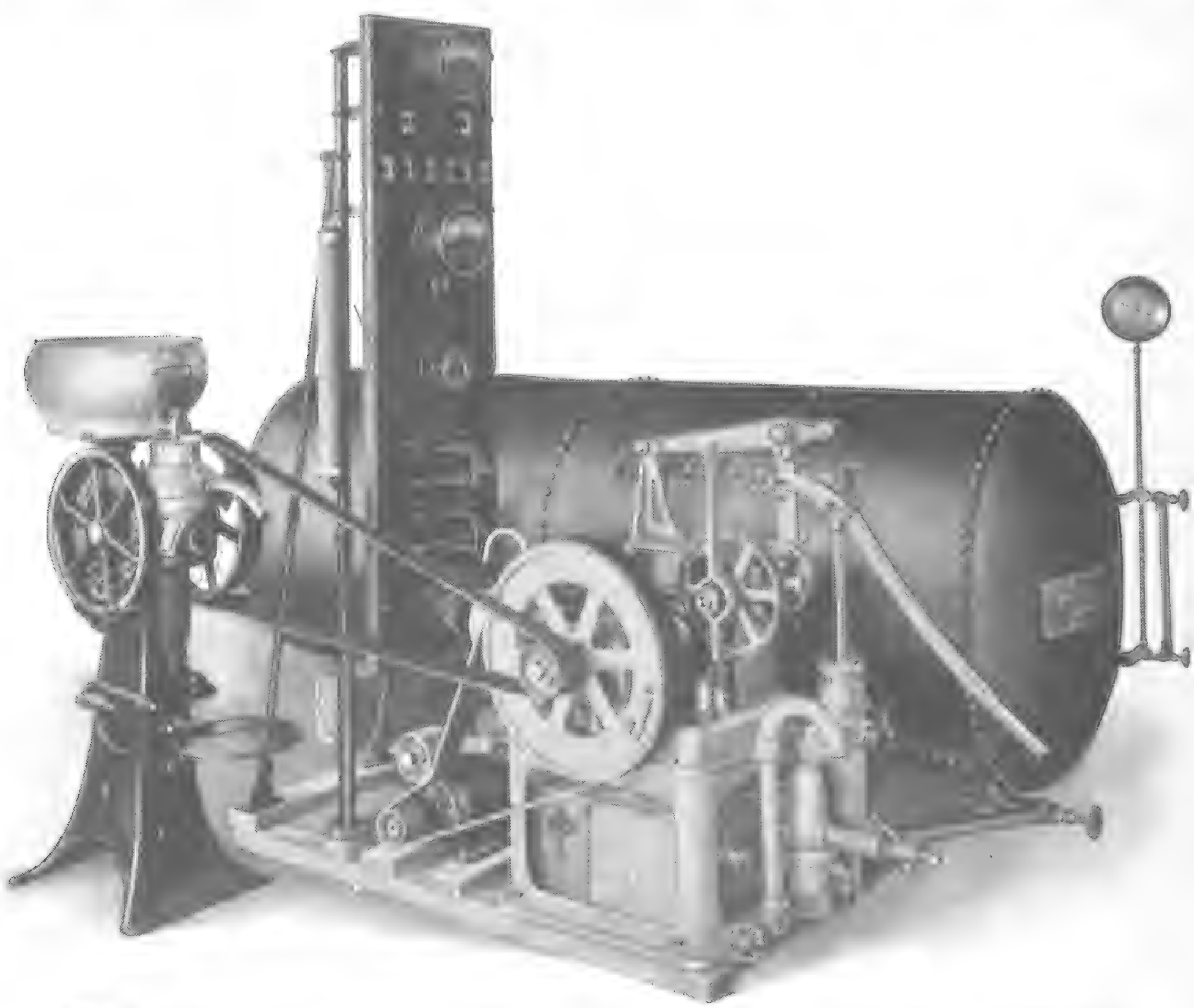

Fig. 1. Pneumatic Pressure Tank Showing Pump and Separator Operated by an Electric Motor.

—*Courtesy Kewanee System.*

twenty minutes a day with a good hand force pump will furnish a moderate supply. If more than 100 gallons a day are required, it is better to use some other means of pumping. If an engine is used, a large tank is more economical, and twenty minutes' pumping twice a week should furnish the supply. With a windmill an automatic regulator should be used, which will throw the windmill out of gear when the pressure reaches a given amount and start it again when the pressure is relieved.

The prices vary with the different manufacturers. A tank 30 inches in diameter and 10 feet long, which would supply the needs of a family of five, is listed at from \$101 to \$138 (subject to discount). The expense for repairs to an outfit like this is very slight and the time required for pumping varies with the power used.

Neighbors can frequently combine and put in one large plant for supplying water to several houses. This decreases the cost to the individual and gives a greater pressure in case of fire. The greater the horizontal distance the water is carried, the larger the pipes should be to lessen the loss of pressure by friction.

Power Available

What will be the most convenient and economical means of forcing water into the storage tank depends upon the situation in each case. The source of the supply, the amount required, the need of power for other purposes, the available fuel, and the cost of labor will all have a bearing on the matter. The hydraulic ram and the windmill have the advantage of operation without fuel, but the ram requires at least 18 inches of waterfall, while with the windmill the daily supply of water is not always subject to control. The gas or hot-air engine requires fuel and attendance, but the supply is more easily regulated.

The Hydraulic Ram

The hydraulic ram can be used to fill the storage tanks if the source of supply is a spring, flowing well, or running stream from which enough fall to supply the power can be obtained. Its use is practicable with a fall of only 18 inches, but with greater heads water can be forced to higher elevations and to longer distances. The head can be increased by damming the stream or by sinking the ram into a pit, if a drain can be secured to keep the pit free from water. The relation between the height of the spring, or source of supply, above the ram and the elevation to which the water is to be delivered determines the proportion of water raised to water wasted. It is not economy to increase the fall more than is necessary to supply the required amount of water, as the durability of the ram will be lessened. The amount of water procured by means of a ram from a very small fall makes a good supply because the ram is always going.

Windmills

The cost of installing a windmill will depend upon the depth and character of the well and its distance from the house and barns, upon the height of the tower, upon the elevation or pressure of the storage tank, and upon the amount of water required each day. These items vary so much with the individual cases that it is unsatisfactory to attempt to give even general figures. Any manufacturer of windmills will furnish an estimate upon application.

Gas or Hot-Air Engines

Small gas or hot-air engines are now manufactured for the express purpose of pumping water from cisterns, springs, or wells to elevated or pneumatic tanks to furnish supplies for houses and barns. One advantage of the engine over the hydraulic ram or the windmill is that the water can be pumped when it is wanted, and the size of the storage tank can be more accurately determined. An engine can be selected which will burn any kind of fuel—natural gas, gasoline, kerosene, coal, or wood. Such engines do not require an expert to run them, and, like the power windmill, can be used for driving other light machinery when not needed for pumping water.

The arrangement of the pipes to carry the water is governed by the same conditions as when other power is used. No more elbows or sharp bends should be

used than are absolutely necessary, as they cut down the capacity of the engine; and when the water is to be pumped through a great length of horizontal pipe it is well to increase the size of the pipe.

The cost of a two or three horsepower engine will be from $60 to $130. The cost of the fuel is very small, as a half hour's pumping a day will furnish the average supply of water.

The House

Location

In selecting a location for a house there are certain points that should be held in mind. A slight elevation, having proper surface drainage, with protecting hills or woods on the north, is greatly preferable to a narrow valley, a low meadow, or the north side of a hill. The house should face so as to get sunlight into all the rooms, if possible, for "where sunlight does not enter the doctor must." This may be accomplished by facing the house southeast, for example, instead of directly east or south.

Foundation and Cellar

After the selection of the site some study should be given to the character of the subsoil, the principal factors to be considered in this connection being the water and the air. There is a certain amount of moisture in the upper layer of the soil which is the cause of damp and unhealthy foundations This dampness is derived mostly from the surface water, and is directly proportional to the absorptive power of the soil and can be diminished by tiling and trenching. The ground air is rendered impure by the gases arising from the decomposition and putrefaction that are constantly going on in the soil, especially in that which is contaminated by household wastes.

In the construction of the cellar the first thing is to provide such drainage as will draw off the water at least one foot lower than the surface of the cellar floor and prevent the ground air from passing through the walls and floors. In building the cellar walls every joint should be entirely filled with mortar. A good coat of asphalt over the outside of the wall turned in at the grade line with a course of slate or bluestone above the ground level will prevent all soaking up of moisture. If a drain tile is laid just outside the footing course and the space on the outside of the wall is filled with sand and gravel all the way up to grade, the surface water will be carried away through the drain.

The floor of the cellar is best made by a layer of brick or of cinder concrete, covered by a layer of asphalt and finished by a 4-inch layer of stone concrete. A layer of well-beaten clay makes a good cellar floor, but it can not be so easily kept clean. The height of the cellar walls above the ground is important. They should extend a sufficient distance above the ground to admit of windows in the cellar at least 2 feet high. This will insure plenty of light and thorough ventilation. There should be cellar windows on all sides of the house.

Plumbing

Important Points to Be Kept in Mind

There is a great difference of opinion among those who have made special study of sanitary plumbing concerning many of the details of construction and design, but the vital things to be kept in mind when laying out the system are to use the best material, isolate all plumbing, and concentrate as much as possible. By "best material" is not meant the most expensive, but the most durable. Secure simplicity in all needed fixtures. Avoid complications in waste pipes. Select sinks without grease traps, bath tubs without inaccessible overflows, wash basins free as possible from fouling places, and water-closets without valves, connecting rods, or machinery.

The drainage system must be so constructed as to carry away completely, automatically, and immediately everything that may be delivered into it. It should be constantly and generally vented, frequently and thoroughly flushed, and have each of its openings into the house securely guarded from the entrance of air from the interior of the drain or pipe into the room. All drains, soil pipe, and waste pipe should be absolutely tight against the leakage of water or air.

The main line of the house drainage system begins at the sewer, flush tank, or septic tank, as the case may be, passes through the house by such a course as may be indicated by a judicious compromise between directness and convenience, past the location of the highest fixture that is to discharge into it, and then out through the roof for free ventilation. If possible, have the fixtures which are located on different floors in a direct line one above the other to avoid any considerable horizontal run. If bathrooms or water-closets are required in different parts of the house let each have its own vertical line of soil pipe. All plumbing fixtures on bedroom floors should be confined to bathrooms, and under no circumstances should there be a wash basin or any other opening into any channel which is connected with the drainage system in a sleeping room or in a closet opening into a sleeping room. Each bathroom should have exterior location and at least one window for light and ventilation, but pipes should not be placed against outer walls unless adequately protected against frost. Never have plumbing out of sight; let each pipe be in full view, and each closet, bath, or basin be unhidden by any sort of inclosing woodwork. There is quite as much danger from the dirt which is apt to gather around concealed pipes and beneath inclosed sinks, bowls, or closets as there is from the admission of sewer gas. The simplest way to prevent the accumulation of dirt is to make it easier to be clean than to be dirty. Therefore keep the plumbing fixtures where there is plenty of light.

Improvements for the Kitchen

The kitchen is a most important part of the house. On it depends the physical life, and to a large degree the spiritual life, of the family. Realizing its importance, sufficient time and thought should be given to it to secure the best results possible from the material at hand.

Ventilation, Walls and Floors

Perfect ventilation is the first requirement of a kitchen, light comes next, and in turn the possibilities of perfect cleanliness. The walls should be painted so that they may be wiped off with a damp cloth, making cleanliness possible without great demand on strength, and without the disarrangement caused by whitewashing and kalsomining. In these days of enameled paint the walls and shelves of all kitchen closets should be painted. Painted shelves can be wiped off with a damp cloth every day if need be. Paper in kitchen closets is always a bid for dust and vermin.

Hard wood makes the best kitchen floors. Linoleum or oilcloth are labor saving and, if cut to exactly fit the floor and all joints cemented, are perfectly sanitary. Intelligence does not countenance a carpet on the kitchen floor.

The Range

Whatever fuel is used, let the range be one of the best in the market. This is true economy. Near the range and under the same ventilating hood should stand the oil or gasoline stove. There is an infinite variety of these stoves, all economical, cleanly, and safe if managed with care.

A hood suspended over the kitchen range and connected to a flue in the chimney will gather all the steam and odors and carry them away.

Laundry Arrangements

When the kitchen is also used as the family laundry, stationary tubs of enameled iron or of soapstone should adjoin the sink. They should be covered to form a table when not in use, but as confined air near plumbing becomes dangerous the covers should close upon rubber knobs or wooden blocks, so as to leave an air space for ventilation. Nickel plated union strips and hardwood wringer holders should be added between the tubs and at the right hand end so that a wringer may be used. One of the needs of the ordinary farmhouse is a suitable place for the workmen to wash as they come from the fields. When a separate room is fitted up as a laundry, provision should be made here for the men by adding a large sink and bench.

The Kitchen Sink

The kitchen sink should be of cast iron, plain, galvanized or enameled, broad, and

of a generous size, preferably with a high back to protect the wall from the water which is certain to splash when drawn rapidly from the pipes. The faucets should be set well up and back to avoid the breakage of dishes by striking them against the faucets. The waste pipe should be covered with a fairly fine brass strainer, which should be held securely in place by screws. At one end should be placed a long draining shelf, the shelf should be well grooved and inclined slightly toward the sink. Both tubs and sink should be well trapped, but as grease traps when neglected are filthy things, and as proper care of the pipes renders them unnecessary in an ordinary kitchen, they should be avoided. Kitchen and pantry sink drains should be treated frequently to a wash of hot water and ammonia or soda to keep them clear from deposits of grease. Kitchen sinks are used for the discharge of liquids which in their original condition are not offensive, but which after a little retention begin to putrefy, and it is very important to secure the complete removal of all such matter well beyond the limits of the house before putrefaction begins.

Refrigerator drains should never connect directly with the drainage system.

Hot Water Apparatus

A hot water supply may be furnished by a special heating apparatus in the cellar, a furnace connection, or, as is usual in small houses, by a boiler and water front attachment for the range. The cold water should always enter the boiler at some distance below the point of entrance of the hot water from the water front of the range; the greater this distance the better will be the circulation, and the less time it will take to heat a certain amount of water. The kitchen boiler is simply a storage tank to keep a supply of hot water on hand so that it can be drawn when required. The chemical properties of the water often determine whether a copper or galvanized iron boiler may be used. Certain waters will rust out a galvanized iron boiler in a few years, while a copper boiler, used in its place, would last a lifetime. The hot water stores itself in the upper part of the boiler and is forced out by the cold water entering at the bottom. The upper pipe, or hot water pipe, from the water front to the boiler must not be allowed to sag but must have as much elevation as possible, and also large sized elbows should be used, in order that the flow of water will have the least possible friction to contend with. The more elevation we get from the water front to the boiler the better the water will circulate, but the slightest rise in the pipe will make a satisfactory job. It should be a continuous rise from the range to the boiler. To prevent the pounding of steam in the boiler an expansion pipe should be provided to allow the escape of steam and air bubbles if the water comes from a tank in the attic. This expansion pipe should open over the overflow from the attic tank. When pressure tanks are used the expansion pipe must be omitted. The sediment which is constantly accumulating in the boiler should be blown off through the stopcock for that purpose, found under every boiler.

The range and boiler are set as close together as they can be for the purpose of getting the best results in regard to the heating of the water. The best kind of pipe for connecting them is either copper or brass, three-fourths or one inch in diameter, with fittings of the same material having threaded joints. Lead pipe is too soft for the purpose and will not stand the high temperatures which the water in these connections often reaches. If it is desired to draw hot water from the different faucets throughout the house at the moment the faucet is opened instead of having to wait until all the water in the pipe has been drawn out, it is necessary to have a circulation of the hot water at all times from the boiler to the different fixtures. The hot water pipe is started from the boiler and carried up, as shown in Fig. 2, to the highest fixture and then connected. The return pipe is carried down, as shown by the direction of the arrows, and this pipe connects with each of the lower fixtures, finally ending at the bottom connection of the boiler. Be sure to have some upward slope at all

points to the pipe which leads from the boiler to the highest fixture; but it is not necessary that the return have a continuous fall.

Installation of the Bathroom Walls and Floors

The bathroom should be a light, well ventilated room with every facility for cleanliness. Floors and wainscoting of tile or composite material are most desirable, but painted walls are much less expensive and give excellent results. Tile is undoubtedly the most satisfactory material which can be used for the covering of the floors and walls where it can be afforded. Tile floor with covered base and walls finished with cement or hard plaster, painted with enamel paint, are much cheaper. When a tile floor can not be had, linoleum is an excellent substitute as it is practically impervious to water. It should be laid before the fixtures are set, in order that there may be no joints. Cement mixed with small chips of marble well rubbed down after setting makes an excellent floor, one that washes as clean as a porcelain plate and has no cracks to harbor dirt; the cost is only about twice that of a double wood floor, or 50 cents per square foot, including the necessary cement bed on which it is laid. When it is desired to lay a cement, composition, or tile floor upon floor joists, proceed as follows: Nail a 2 by 4 to the side of each of the floor joists flush with the bottom. Upon the top of these stretch wire lath, after the joists have first been covered with tarred paper to prevent them absorbing moisture; and upon this lay cinder concrete, made of one part Portland cement, three parts loose sand, six to eight parts crushed and screened furnace clinkers; filling in to a level at least two inches above the tops of the joists Upon this is placed the floor finishing Cinder concrete is used because it is so much lighter than that made of stone. When a tile or cement wainscot is too expensive the walls should be painted. Wall paper is not desirable in a bathroom, nor is wood paneling.

Bath Tub and Lavatory

A porcelain lined or enameled iron bath tub is the best medium priced tub. For supplying the tub with water a combination cock is best, allowing hot or cold water to enter the tub separately or the temperature to be regulated to suit the bather. The cock should be placed high, so as to allow of water being drawn into pitchers.

The best lavatories are those of porcelain or enameled iron, with back and overflow all formed as integral parts of the fixture. The basin cocks through which the hot and cold water come are of various shapes, the simplest being the best.

The Closet

The water closet is the most important plumbing fixture in the house, and should be selected and put up with particular care. A good closet should be simple, neat, and strong, of a smooth material, with ample water in the bowl. Among the modern closets there is none more satisfactory than the flushing-rim, siphon-jet closet, which can be had, including the trap, in a single piece of porcelain. Porcelain is used because no other material can be kept so clean and sanitary. But even this is an imperfect protection from dirt and disease unless the bowl is flushed so as to clean it completely and absolutely. The water should be poured from the rim of the bowl, so that every part of it is perfectly cleaned The wash-down and wash-out closets are similar in make, but are not so thorough in their action. In the wash-out closet the basin acts as a receiver, a small quantity of water being retained in it, and into this the deposit is made, to be washed out afterwards into the trap by the flush. The water in the basin is prevented from leaking into the trap by a raised ridge which is apt to break the force of the flush so that its whole force is not directed into the trap, which is objectionable. The wash-down closet receives the deposit directly into the water held in the bowl by the trap. It has a straight back and a much smaller fouling surface. There is no open vent. The outlet is en-

tirely covered with water, so that the water does not throw the soil against the side. The only advantage the siphon closet has over it is the greater force of discharge given by the siphon.

The siphon closet, like the wash down closet, retains a certain amount of water into which filth is discharged. In addition there is a siphon trap provided with a long ascending arm, so that the water in the trap is at a lower level than the water in the bowl. The water from the flushing cistern is directed not only into the bowl, but downward into the trap itself. As a result of this discharge into the trap a siphon action is produced whereby the contents of the bowl are sucked through the trap into the soil pipe without soiling the bowl. The seal—that is, the body of water which prevents the sewer gas from escaping into the house—is deep, broad, and always in plain sight.

Flushing Apparatus

The flushing cistern or tank for a water closet is always distinct from the main water supply. As a rule, a plain hardwood box, copper lined, is supported by brackets from the wall about 7 feet above and communicating with the closet by a pipe. This pipe is usually about 1½ inches in diameter and should have as few bends and angles about it as possible. The cistern should hold 2 or 3 gallons of water, all of which should be discharged at one time into the closet. The flush of the closet should be quick, powerful, and noiseless, thoroughly scouring all parts exposed to fouling.

The flow into the cistern is regulated by a float valve which allows the tank to fill, the float rising with the water; when it reaches the proper level the float is entirely raised and the supply shut off. When the tank is emptied by opening the flush valve, which is lifted by pulling a chain attached to it, the process is repeated. The cistern is usually provided with an overflow connected with the flush pipe, so that if the ballcock fails to act properly in shutting off the water the surplus will escape through the water closet to the drain instead of overflowing.

Soil-Pipe Connections

The best closets are provided with a brass screw soil-pipe connection, calked with lead and cemented into the base of the closet. The corresponding threaded brass coupling is soldered into the end of the lead bend which connects with the soil pipe. The closet is then screwed into the threaded coupling until the base rests on the floor. The closet may be removed at any time by simply unscrewing it. No bolts are necessary through the base flanges. In setting a water closet a neater finish can be obtained if a porcelain floor slab is put in with the finished floor.

General Suggestions

The important need of the work is simplicity, not only in detail, but in general scheme. Construct the water closet to be used as a urinal and slop sink and arrange to draw water through the bath cocks placed at the top of the tub. It not only saves cost, but is a great advantage to have the fewest possible points requiring inspection and care and to secure the most frequent possible use of every inlet into the drainage system. Great care must be taken not to throw into the water closet hair, matches, strips of cloth, or anything which is insoluble and liable to clog the trap and soil pipe. A burnt match seems small in itself, but if lodged in the trap it will collect other things and cause serious obstruction of the outlet. Tissue toilet paper should be used. Its cost would be exceeded many times if a part of the system needed to be taken out to free it from newspaper obstruction. It is often found more convenient to have the water closet with a separate entrance from the hall and entirely independent from the bathroom.

Traps and Vents

Every plumbing fixture must have a trap to prevent the foul air from coming back from the drain through the waste pipe. In its simplest form a trap is a downward bend in a pipe, so deep that the upper wall of the pipe dips into the water held in the bend, the extent to which it dips being known as the depth

of the seal. With slight modifications this is the trap most commonly used for wash basins, laundry tubs, etc. Its greatest fault is the danger from siphonage; that is, the water seal may be carried out of the trap into the soil pipe by the rush of the water when the fitting itself is emptied, by the flow of water from another fixture on the same branch waste pipe, or by the discharge of water from a fixture higher up but connected to the same soil pipe. This danger is much lessened by the introduction of a system of ventilation pipes extending upward either from the trap itself or from the outlet near the trap. To avoid this extra expense of a third system of pipes, it is better to supply each fixture with one of the patent non-siphonage traps, which should also be self-cleansing. There are several good ones on the market. It is a good habit, after emptying the wash basin, bath tub, or kitchen sink, to allow some clean water from the faucet to run into the fixture in order to have clean water in the traps. All traps should be provided with trap screws, placed below the water line, and arranged so as to be accessible for cleaning.

Nothing short of continuous use will prevent the evaporation of the water in the traps. One with a large dip is best, but at the same time the trap must be so formed that at each use of the fixture all the filth that is delivered shall be carried away, the trap being immediately refilled with fresh water. Hair and fibers from cloth sometimes carry the water out of traps by capillary attraction, and care should be taken not to allow such things to enter the pipes.

The Soil Pipe

The soil pipe should extend from cellar to roof in a straight line, if possible, as each offset or bend forms an obstruction to its proper flushing with both water and air. Use only "extra heavy" soil pipe of uniform thickness throughout, as the hubs stand the calking better.

Avoid if possible plumbing fixtures in the cellar if the drain must go under the floor. If it is necessary to make connections with a fixture in the cellar it is better that the main channel should run under the floor to or near the location of such fixtures that all or nearly all of its length should constitute a part of the main drain thoroughly flushed and ventilated like the rest of the system. The pipe should be laid in an open trench and so thoroughly calked that under a pressure equal to one story in height not a drop of water should escape at any point, and then it should be inclosed in good concrete, after which the trench should be filled. The soil pipe should pass through the foundation by means of an arch, and the cast iron pipe should extend at least 5 feet outside the foundation; from there on, a carefully laid and rigidly inspected vitrified pipe drain is to be preferred. The joint between the iron pipe and the vitrified sewer pipe should be made with neat Portland cement mortar. If there are no fixtures in the cellar carry the drain in full sight along the face of the cellar wall, or suspended from the floor beams, so the joints may be inspected. At the point where it is to turn up as a vertical soil pipe support it by a post or a brick pier. Use no short turns in the soil pipe, like "tees" and "quarter bends." Two one-eighth bends or a Y branch and a single one-eighth bend give a more gradual and therefore a better change of direction. Water closets should connect to the soil pipe with a Y branch. The soil pipe should be secured along its entire length at distances not over 5 feet with hangers and clamps or hooks, so that it will be rigidly held in position. The joints in the cast iron soil pipe should be made by first inserting a little picked oakum into the socket, allowing none to enter the pipe; it is better formed into a sort of rope. The oakum prevents the lead from running into the pipe to form an obstruction to the flow. Enough molten lead is then poured into the hub to fill it. After the lead has cooled it is carefully hammered with a special calking tool until the space between the spigot and the hub is perfectly gas and water tight. Every joint should be made with a view to being tested with hydraulic pressure.

In making this test the simplest way is to close all openings into the pipe with wooden plugs or disks of india rubber compressed between two plates of iron forced together with a screw. There is no especial advantage in applying a great head of water, for if a joint is not tight it will leak under a head of a few inches. It is generally most convenient to test the vertical pipe story by story, the plugs being inserted through the water closet branches. There is probably no occasion to fear that work once made tight will develop leaks for many years, the tendency to rust after a time, even with tar-coated or enameled pipe, being rather to close such slight leaks as may exist.

Four inches in diameter is sufficient for soil pipe, and the best results are obtained by running it full size straight above the roof and covering the top with a wire basket such as is used to keep leaves out of gutters.

There should always be a trap between the house and the sewage disposal plant, and there must also be on the house side of it an inlet for fresh air. There can be no real ventilation of the system if it is open only at the top, but a generous inlet for fresh air on the drain outside the house, in connection with the opening at the top of the soil pipe, will insure a free movement throughout the whole system. The fresh air inlet must be guarded from obstruction. It may be brought out close to the foundation walls, but not too near windows and doors. If the trap is formed by the submerging of the inlet pipe in the settling chamber of the disposal system the fresh air inlet should be placed close to this.

The Waste Pipes

For all minor waste pipes lead pipe is used, as it may be bent and cut to suit all possible positions and requires but few joints. Only "heavy" lead pipe should be used. As lead is quite a soft material it would not be practicable to use thread joints on it, so the joints are made by the use of solder. Where lead pipe joins to cast iron pipe the connection should be made by means of a brass ferrule of the same bore as the lead pipe, and soldered to it. The ferrule is introduced into the hub of the cast iron pipe and calked tight with oakum and lead.

Heating Systems

The Ideal System

The health and comfort of the home depends to a considerable extent upon the heating apparatus, which, in importance, is second only to that of sanitary plumbing. Stoves are a development of the fireplaces of our ancestors. Their waste of fuel, their uncleanliness, and their inability to properly heat even one room are features recognized by most people. The ideal heating apparatus is one that will promptly and continuously supply every room in the house with enough warm fresh air to make it comfortable in the coldest weather. It must be easy to manage and not complicated in construction. The cost of installing a steam or hot water system is more than that of a hot air furnace. The amount of fuel used by them is less, but for a small house the hot air furnace is most often used. It has the advantage, too, if properly installed, of supplying fresh air, while the other systems demand special means for ventilation, or dependence must be placed entirely upon opening the doors and windows.

Furnaces

A furnace is a stove within a casing of galvanized iron or brick. Air is admitted to the space between the two and when it becomes heated passes through pipes to the different rooms of the house. The furnace may be constructed of cast iron, wrought iron, or steel. The cast iron furnace has fewer joints than the one made of steel plates and will not vary in temperature so rapidly.

Direct and Indirect Draft

In construction there are two styles, the "direct" and the "indirect" draft. The better class of the "direct" draft furnaces have a radiator through which the hot gases pass on their way to the smoke-stack, and so utilize much heat that would otherwise be lost. In the "indirect" draft furnaces the gases pass

through radiators at the bottom and from there to the smokestack. A direct passage is furnished to be used when the fire is being started or when coal is being added. Some furnaces are "built to sell" by their size and are not furnished with a radiator. These will burn more fuel and give off less heat.

The Smoke Pipe

The smoke pipe should connect to the chimney as directly as possible, for elbows diminish the draft. The flue should be at least 8 inches by 12 inches and should have no other opening into it for range or fireplace. A clean-out door should be provided at the bottom, fitted with a tight door, and this door must be kept shut, except when cleaning out the flue.

The Grate

The grate is one of the most important parts of a furnace, and there are many kinds to be had. The essential things are the removal of the ashes and cinders from the entire grate surface without carrying unburned coal with them, and the admission of air to secure proper combustion of the fuel. In comparing furnaces the average diameter of the fire pot is taken. The space above must be large enough to permit of the thorough mixing of the gases with air or else much heat will be lost by imperfect combustion. If soft coal is to be burned a larger combustion chamber is needed than with hard coal, as the supply of air must be greater.

Furnaces differ in the manner of bringing the air to be warmed into contact with the surfaces heated by the combustion of the fuel. The area of the heating surfaces should be about 60 times the area of the grate surface to prevent overheating of the air in cold weather.

Where natural gas is available the furnace can be arranged to burn it, but it is well to have a coal grate also in case the gas should be shut off. Wood furnaces are generally more simple in construction and are often built to take a 4-foot stick. Where wood is cheap excellent results may be obtained. The smoke should pass through a radiator, as in case of coal furnaces.

Distribution of Hot Air by Means of Pipes

Much depends upon the location of the furnace. It should be placed somewhat to the north and west of the center of the house—that is, toward the prevailing cold winds. As the hot air travels best through the pipes leading toward the sheltered part of the house and to the upper rooms, the pipes leading toward the north and west or to the rooms on the first floor should be given the preference with respect to length and size. Make all pipes as nearly the same length as possible and as short as the location of the registers will permit. Long horizontal runs of pipe should be avoided, especially in first floor pipes. The pipes should pitch upward as sharply as possible so the resistance will be less. Each pipe should have a damper near the furnace. Each room should have a separate pipe, if possible, or the heat will go to the less exposed room when a wind is blowing. Exposed pipes should be provided with an asbestos covering, even when made double; double pipes are the best for all work. Bright tin is almost always used for hot air pipes, as it radiates less heat than any other suitable material. The registers should be as near the furnace as possible. Nothing is gained by putting them on the exposed side of the room and much heat is lost. First floor registers may be placed in the floor if wall registers would interfere with the pipes to the second floor. Second floor registers should be placed in the wall so as to avoid the necessity of cutting carpets and not to furnish receptacles for dirt. If only the first floor is heated the registers should be placed in the wall. The net area of the register should be about 15 per cent greater than the section of its hot air pipe.

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Fermentation and Ferments

No. 1—Insoluble Ferments

Fermentation is a chemical change produced by a class of bodies called ferments. Insoluble or organized ferments are single celled, microscopic plants

which have a definite structure. Nearly all of them secrete definite chemical products capable of producing fermentation. The insoluble, or organized ferments, are composed mainly of nitrogenous compounds, but also contain non-nitrogenous and mineral matter. Some, as the tubercular organism, contain cellulose.

No. 2—Soluble Ferments or Enzymes

Enzymes are organic compounds, secreted by cells, and have the property of producing chemical changes. They are also called soluble ferments, chemical ferments, and diastases. Diastase is a white amorphous compound, converting starch by fermentation into dextrine and sugar. It is found in the sap of plants, and in animal saliva. There are a great many kinds of soluble ferments, some of which as diastase are capable of acting upon carbo-hydrates, while others, as pepsin and pancretin, act upon proteid bodies. Enzymes produce chemical change, without entering into the composition of the substance or giving up any of their material to the reacting compounds. A small amount of diastase will change a large amount of starch to soluble forms, without losing its power of action. The enzymes are all soluble in water and are precipitated with strong alcohol. Their action is not generally retarded by antiseptics and chemicals which are capable of destroying the organized ferments. When seeds are soaked in water, the diastase and proteose enzymes are extracted and if precipitated in alcohol and recovered they appear as a light gray powder. An organized ferment is a low form of plant, while a soluble ferment is a chemical compound.

No. 3—Aerobic and Anerobic Ferments

Ferments that require oxygen for their existence are aerobic while those capable of working in the absence of oxygen are anerobic. The aerobic ferments produce carbon dioxide, water, ammonia and hydrogen sulfid as final products while anerobic ferments usually produce intermediate products as organic acids.

No. 4—Conditions Necessary to Fermentation

The conditions necessary to fermentation are:

(1) Moisture. (2) Favorable temperature. (3) A ferment body. (4) A fermentable substance.

Moisture is necessary in order that chemical changes may take place. During fermentation water enters often into the chemical reaction, as in hydration changes, and is also necessary as a medium of exchange for the chemical products of the reaction.

The most favorable temperatures for the fermentation are between 15 and 60 degrees Centigrade. Below zero and above the boiling point of water, ferments are inactive. Some ferments require a different temperature for activity from any others.

A ferment body is always necessary to start the fermentation change, and in the absence of a ferment, either organized or unorganized, no ferment can take place.

A fermentable substance, with the right kind of ferment to act upon it, is also requisite, as a ferment which acts upon one class of bodies is incapable of changing starch to soluble forms. When a substance is freed from all ferments and is protected from all sources of outside contamination, it is in a sterile condition. Many forms of fermentation are produced by the spores of organized ferments gaining access to a material along with dust particles carried in the air. In the preservation of food, a knowledge of the conditions necessary for fermentation is made use of. The products formed by ferments are numerous, as are ferment bodies capable of acting upon all forms of organic matter. Some of the ferments assist in the digestion of food and in the preparation of food products, while others take an important part in every-day life affairs, and in agriculture in the liberation of plant food. The growth of plants, the preparation of foods, their digestion and the manufacture of food products all depend largely upon fermentation.

In the growth of plants, ferments play an important part, both in the preparation of plant food and in the chemical changes that take place in the plant. *Disintegration of the mineral food of the soil is assisted by ferment action.* The nitrogenous food of the plant is all prepared in the soil by ferment action.

Aceteus or Acetic Fermentation

A form of oxidation in which alcohol is converted into vinegar or acetic acid by the agency of a specific fungus or ferment called "*Mycoderma aceti.*" The process involves two distinct reactions in which the oxygen of the air is essential. An intermediate product called "aldehyde" is formed in the first process.

1 $C_2H_6O + O = H_2O + C_2H_4O$.

2 $C_2H_4O + O = C_2H_4O_2$.

Alcoholic Fermentation

The fermentation which saccharine bodies undergo when brought into contact with the yeast plant or torulae. The sugar is converted either directly or indirectly into alcohol and carbonic acid, the rate of action being dependent on the rapidity with which the torulae develop.

Ammoniacal Fermentation

The conversion of the urea of urine into ammonium carbonate, through the growth of the special urea ferment. Whenever urine is exposed to the air for several days in open vessels, it undergoes this alkaline fermentation.

Butyric Fermentation

The fermentation of various forms of organic matter through the agency of a peculiar worm shaped vibrio, with the formation of more or less butyric acid. It is one of the many forms of fermentation, that collectively constitute putrefaction.

Enzymatic Ferment

This has already been described.

The Fermentation Theory of Disease

The theory that most, if not all, infectious or zymotic diseases are caused by the introduction into the organism of the living germs of ferments, or ferment bodies, already developed, (organized ferments) by which, processes of fermentation are set up injurious to health. This is akin to the germ theory of disease.

Glycerine Ferment

The fermentation which occurs on the mixing of a dilute solution of glycerine with a peculiar species of schizomycetes and some carbonate of lime and other matter favorable to the growth of the plant, the glycerine being changed into butyric acid, butyl and ethel alcohol. With another form of bacterium (*Bacillus subtilis*) ethel alcohol and butyric acid are mainly formed.

Lactic Fermentation

The transformation of milk sugar or other saccharine body into lactic acid, as the souring of milk, through the agency of a special bacterium (*Bacterium lactis* of Lister). In this change the milk sugar, before assuming the form of lactic acid, presumably passes through the stage of glucose.

FERTILIZATION. See *Apple Orchard.*

FERTILIZER, COMMERCIAL. See *Apple Orchard Cover Crop.*

Fertilizing Value of Rain and Snow

Experiments have been conducted during the past few years at the Canadian Experiment farms by F. T. Shutt, relating to the fertilizing value of rain and snow. The report for 1911 shows that during the year the precipitation amounted to 26.97 inches, the total nitrogen per acre brought down by rain and snow was 5.27 pounds, about 84 per cent being furnished by the rain and 16 per cent by snow. Of the total nitrogen 3.73 pounds was in the form of free and albuminoid ammonia and 1.54 pounds nitrates and nitrites.

E. S. R.

Figs

The fig is the fruit of any one of the various species of the cultivated varieties of *Ficus carica.* Fig trees vary greatly in habit, some of them being low trailing shrubs, others gigantic trees. They have alternate leaves, which abound in a milky juice, usually acrid, though in a few instances sufficiently mild to be

used in allaying thirst. The figs of commerce are grown on a small tree or shrub, rarely more than 20 feet in height.

The fig seems to be indigenous to Syria and Asia Minor, but for a long period of time has been grown in the countries around the Mediterranean sea and judging from passages in the writings of Herodotus, and from the Hebrew scriptures, it was an article of food and commerce, centuries before the Christian era.

In the warm countries, the tree generally bears two crops in one year, the first in the early summer from the buds of the previous year, the other in the autumn from the buds of the spring growth.

Fertilization

The question of the fertilization of figs was early little understood. It was believed that the flowers were unisexual and therefore from very ancient times it was the habit of certain growers to place branches of the wild fig in flower over the cultivated varieties, in order that the pollen from the wild flower might fertilize the female flowers of the other From the Louisiana Experiment Station, we quote the following on the subject of fertilization·

Southern figs produce *pistillate* or *female* flowers and *mule* or *sterile* flowers. While they do not produce *staminate* or *male* flowers, nevertheless, they possess the ability to develop an edible product, with no true seed. It is impossible for any of our figs to produce true viable seed, hence unless figs of another class capable of producing seed are grown in Louisiana, one may never expect a variety of figs of Louisiana origin. The different blooming habits of our figs easily separate them into three distinct divisions.

Class 1—*Mission Figs*, capable of producing both an early and a late crop.

Class 2—*Adriatic Figs*, capable of producing a late crop, but dropping all of its first crop.

Class 3—*San Pedro Figs*, capable of producing an early crop, but dropping all of its late crop.

The *sterile* or *mule* flowers are the ones that develop into our edible fig. The *pistillate* or *female* flowers invariably drop off.

In the Mission class of figs the *sterile* or *mule* blooms predominate in both its *early* and *late* crops, hence, climatic conditions being favorable, two crops of figs may be obtained.

In the *Adriatic Figs* the *pistillate* or *female* blooms predominate in the *early* crop, and the *sterile* or *mule* blooms predominate in the *late* crop, hence the *early* crop drops, and the *late* crop matures.

In the San Pedro Figs, the *sterile* or *mule* blooms predominate in the *early* crop, and the *pistillate* or *female* blooms predominate in the *late* crop, hence the *early* crop matures and the *late* crop drops.

Occasionally *sterile* or *mule* blooms on both the early crop of the Adriatic type of figs and the late crop of the San Pedro type of figs may develop into edible fruit.

GRANVILLE LOWTHER

Propagation

The fig is easily propagated by cuttings, layering, ring-budding, and grafting. Propagation by cuttings is the easiest and most satisfactory way. The work can be done at almost any time of the year; but by far the best results are obtained if done during the winter while the plant is dormant.

The cuttings should be taken from strong, healthy plants of the desired variety and preferably from plants growing in the immediate locality. Select the one-year-old branches that are plump and stocky, which are usually found on the outside, where they were well exposed to the light. Do not take the long, slender shoots or suckers found on the base of the plant.

A good cutting should be at least one foot long, or preferably longer. The cut ends should not expose any pith, but the hard wood of the partition found at the node. The cuttings should not be allowed to dry out, or become shriveled; as soon as made they should be tied into bundles of convenient size and buried in moist sand. The following spring they should

be planted either in the field where they are to remain permanently or in the nursery row. The latter method is usually preferable, as they can be given better care and grown at less expense. They should be planted deep, leaving only the uppermost bud just above the surface of the soil. Some prefer to make the cuttings late in the spring and plant them at once in the field. This is certainly the most economical method.

Planting

The soil should be thoroughly prepared by deep plowing and enough disking and harrowing to pulverize every clod. Usually clay soils are not plowed deep enough, especially by the beginner. It must be remembered that the fig is naturally a very shallow-rooted plant, especially where the subsoil is hard and comes up near the surface. Clay soil should be plowed eight to ten inches deep and then subsoiled to a depth of six to eight inches. This gives opportunity for proper root development, and storage of large quantities of water.

The best time to do the planting is in the spring. Fall planting is not advisable, as the young plant can not endure very much cold until it becomes well established. If the planting is done in the fall or winter the young plant should be entirely covered with dirt until spring.

The distance apart to plant will depend on the variety and the method of training, whether in tree or bush form. Such semi-dwarf varieties as Brown Turkey are usually planted 10x10 or 12x12 feet apart in this state. Large growing varieties, like Celestial, need more room—15x15 to 20x20 feet.

For best results the fig should be planted deep. The young plant should be planted from four to six inches deeper than it stood in the nursery row; and then the entire top of the plant should be cut off at the surface of the ground. This induces a number of branches to come out from below the ground, which give the clump or bush form so desirable in the Upper South. If the cuttings are planted in the permanent places in the field the plants should be cut down to the ground one year after planting. Some growers put from three to five plants or cuttings at each place instead of one, with excellent results.

F. C. Reimer,

Horticulturist, North Carolina Agricultural Experiment Station, West Raleigh, N. C. Bulletin 208.

Pruning

As the Magnolia fig bears only on late wood of the previous year's growth or new wood of the current year's growth, the object is to produce as much new wood as possible—as in growing grapes.

Standard Heads

First Year

Allow three to five limbs to start close to the top so located as to make a well balanced head, and rub off all other limbs and remove all suckers that may start from the base of the tree.

Second Year

Cut previous year's growth back to within 12 inches of main stem. When growth starts allow each of the stubs to throw out two or three limbs, keeping all others off.

Third Year

Cut previous year's growth same as second year, and allow them in turn to produce two or three limbs each.

Tools

For cutting back, small and large pruning shears should be used; for removing suckers from the root use a carpenter's gouge chisel.

Soils

The fig will grow on most soils, but commercial plantings should be confined to heavy black land and black sandy land, and it must be underlaid with porous clay subsoil not more than two feet below the surface. The reason for this selection of soil is that the only dangerous disease attacking the fig is what is commonly known as Knot Root (*Nematode*), and this seldom does injury in heavy black soil. The reason for this, I believe, is that the heavier the land is the less oxygen there is available, and the parasite cannot exist without a certain amount of this element.

R. H. Bushway,

Algoa, Texas.

Districts Where Grown

Figs are grown in hot houses, or in specially protected places, in the Northern or Middle states, or they are sometimes grown in very limited quantities by specially protecting the tree from the freezing of winter. But the districts where it can be grown in commercial quantities, according to the recommendations of the American Pomological Society are as follows:

District No. 4—Turkey Brown.

District No. 5—Angelique.

District No. 6—Angelique, Brunswick, Celesta, Genoa, Turkey Brown, Marseillaise, Mission, Monaco, Bianco, Osborn Prolific, Reine Blanche.

District No. 7—Celesta, Turkey Brown, Mission, Monaco, Bianco, Osborn Prolific, Reine Blanche.

District No. 16—Mission.

District No. 17—Mission.

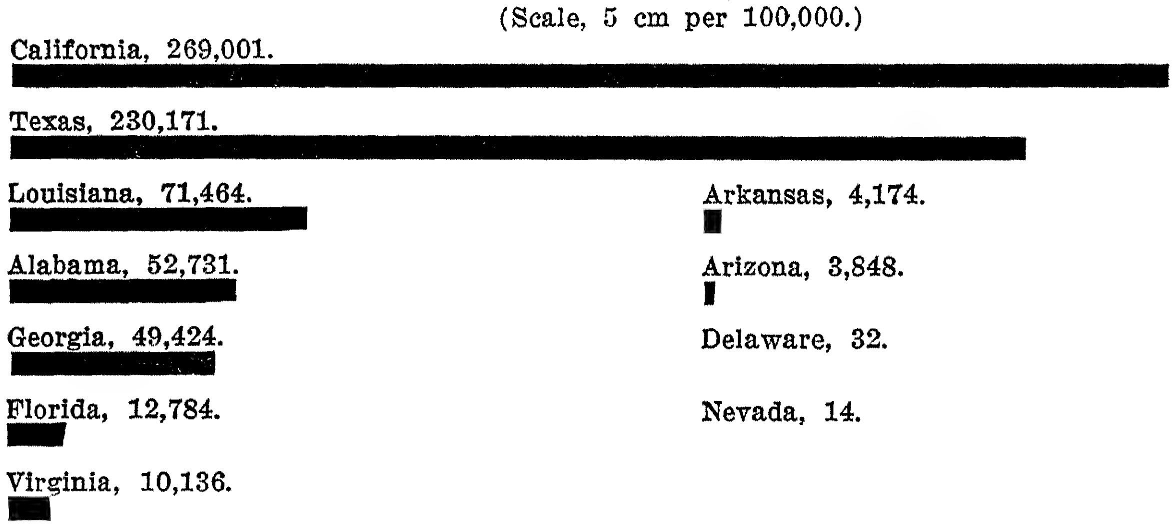
For description of districts see page 192.

For further information and for profits from FIG CULTURE, see *Alabama*.

Figs in the United States

There are but few states in the Union which produce figs for commercial purposes. The following are reported in the census of 1910 and the number of bearing trees produced by each state appended:

(Scale, 5 cm per 100,000.)



Floriculture

JOHN W. DUNCAN.

Spring Flowering Bulbs

In the early days of spring the first flowers to appear are such as the snowdrop, the crocus or the scilla, to be followed a little later by the tulip, the hyacinth and the many varieties of narcissi, see Fig. 1. In order to have a good showing of these flowers, they should be planted during the fall months of October and November. This gives the bulbs a chance to form roots so that they have a stronger start in the spring. When beds are to be solidly planted with these bulbs, the soil should be well prepared and a rich sandy loam is undoubtedly preferable.

It is very essential that the beds should have perfect drainage so that there is no danger of water standing on the ground during the winter, which has a tendency to rot or weaken the bulbs. The soil should, if not naturally sandy, get a good coating of sand mixed into it and should be dug to a depth of at least 15 inches. Well rotted cow manure is perhaps the best fertilizer that can be used, but fine ground bone will also be beneficial. The beds are better to be raised a few inches higher than the surrounding ground, to effect a more perfect drainage.

In planting bulbs, many people put a small quantity of sand around each bulb, or often the top soil is taken entirely off the bed to the depth at which the bulbs are to be planted, a coating of sand then spread over the bed, the bulbs then set the proper distance apart and the top soil carefully replaced. Where the bed has been prepared as mentioned in the first place, this plan need not be

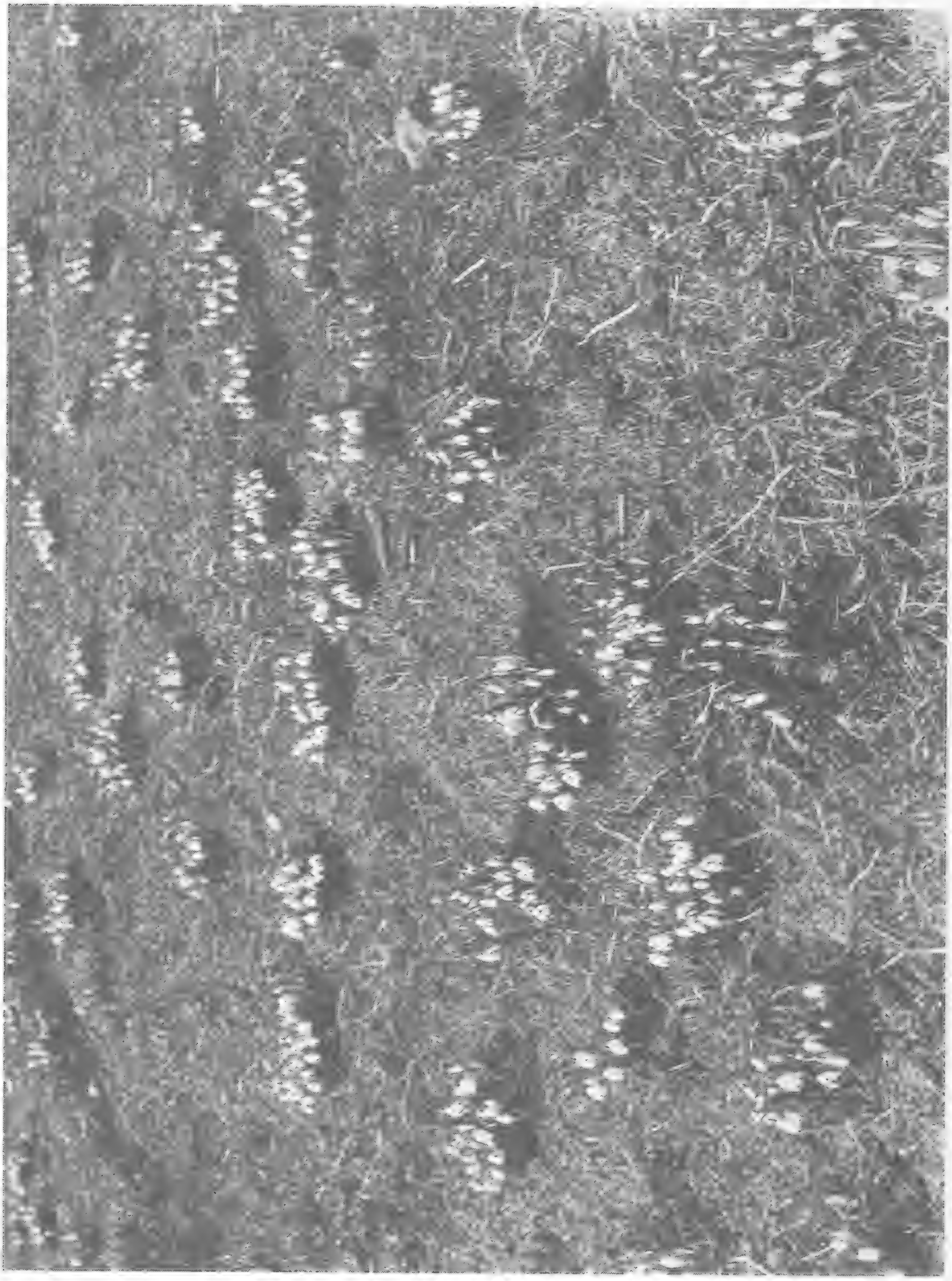


Fig. 1. Snowdrops in Grass

Fig. 2. Golden Chain (*Labrum alpinum*)

adopted as the bulbs may be more readily planted with a trowel. The depth at which each bulb should be planted depends mainly on variety but care should be taken that each bulb in a bed should be planted at the same depth, so as to insure blossoming at the same time. From four to five inches is deep enough for tulip bulbs and five or six for hyacinths, while small bulbs like the crocus and scilla, etc., three to four inches is sufficient, but better results will follow from a little too deep planting than from too shallow. Larger bulbs like lilies should be planted to a depth of from eight to twelve inches. If in a section of country where the ground freezes during winter, a coating or mulch of coarse litter or leaves should be put on the beds to protect the bulbs from too severe freezing and the changes from freezing and thawing of the ground. This mulching should be removed as early as possible in the spring. In many instances it is necessary to lift the bulbs so that something else may be planted in the beds. This may be done before the plants are thoroughly ripened by lifting with a little dirt along with each bulb which may be placed in a row somewhere else until ripened, when they may be laid past for another season's planting.

In the hardy border, bulbs may be planted in patches among herbaceous plants. They will not only do well and make the border look showy in the earliest days of spring, but have a good chance of ripening there and need not be disturbed from year to year. Where bulbs are grown this way, annuals may be planted to take their places through the later summer months. Some of the varieties of bulbs, like the crocus, snowdrop and the scilla, may be effectually planted in the lawn and make a good showing in the early spring immediately after winter is past.

In semi-wild gardens these bulbs are very effective planted along with such plants as the erythoniums, bleeding hearts, etc. When this is done, each variety or color should be in as large a patch as possible. Nature always plants this way.

Lawns

The importance of a good lawn is one of the principal features of ornamental gardening. Contrary to the expectations of many, a first-class lawn cannot be obtained unless there is sufficient depth of soil and the same has received the proper preparation. It should always be borne in mind that grasses are deep-rooted plants and if a fine velvety luxuriance is to be had, the soil must be from 12 to 18 inches deep. In many places we see only a few inches of soil spread on the top of a poor sub-soil, or gravel, or even often on a ledge of rock and a lawn started and kept green on the same by means of copious and almost continuous watering. In no instances of this kind, however, can a good lawn be expected. That fine velvety touch of the good lawn is found only where consideration has been given to the various grasses of which the lawn is composed.

Any good soil is suitable for a lawn. It will, however, need some attention to prepare it for the proper plant food. If it is sandy or gravelly, attention should be given to the addition of humus. If, on the other hand, the soil is clayey, or should contain signs of alkali, attention should be given to counteract these and bring into the soil more of the plant foods required by the grasses For the counteraction of alkali in soils abundant quantities of manure should be plowed into the soil and turned up to the storms of winter.

In preparing the soil for seeding, it should be deeply plowed, well drained and properly graded and finished to an even surface with an iron rake. In seeding a small lawn the sowing may be done by hand but care should be taken to scatter the seed evenly. On a large lawn a hand or power seeding machine may be used, and in many cases it is desirable to use various grasses on a lawn; in fact, it is always advisable to use several species. The reason for this is that some grasses will thrive better in some soils than others, and by using a combination

Fig. 3. Engleman's Spruce (*Picea englemani*)

experience has shown that a better lawn will always be obtained. A good lawn mixture is a combination of Kentucky Blue Grass, Fancy Red Top and Creeping Bent in equal parts with, if desired, a proportion of ten per cent (10%) White Clover.

In sections where the winter is not severe, the seeding may be done in the spring or early fall, while in some of the mountainous sections, early summer will be more satisfactory for the starting of the young grasses. Where summer seeding is done, proper care must be given to the watering and it has been found of great advantage to cover over the ground with a light mulch of well rotted manure. This prevents the hot sun from burning the young rootlets of the small grass plants and also helps to hold moisture after watering. The proper care of lawns after they are established consists of cutting the grass at the right time, sufficient watering and the keeping free of obnoxious weeds. The latter can be done only by persistent work from the start in taking them out by the roots. Occasional rolling is beneficial in that it keeps the soil of an even nature. Mowing should not be done as often as sometimes seen; in fact, most people are apt to cut the grass too closely, thus preventing the lawn having that velvety texture so much desired. Good judgment is also required in watering and it is much better to give a good watering and then let the lawn remain until such time as it may actually need watering rather than to sprinkle too often.

In the autumn the grass should not be cut too short for during the winter months, at mild intervals, weeds will start in and get ahead of the grass which has been weakened by its continuous cropping and therefore cannot cope with its more sturdy neighbor, the weed.

Many different fertilizers are used; perhaps one of the most satisfactory is fine ground bone applied in liberal quantities at various seasons of the year. Sheep manure is also one of the best natural fertilizers that may be applied towards the end of winter.

Ornamental Trees

For the decoration of grounds, both public and private, there are many varieties of ornamental trees both deciduous and evergreen that may be used and where the grounds are of sufficient size to warrant the grouping of different species to give the most picturesque effect much studying is required.

In the planting of parks or parking, the main thought should always be the appearance of the picture when completed and the size and shape of the tree, the foliage effects both summer and fall and harmony with its neighbor, all require forethought.

In general street planting, much more care is necessary than is generally seen in the preparing of the parkings for the trees. When new streets are being laid out, little or no attention is paid to the planting space. The street parking should have sufficient quantity of good loam for the development of whatever variety of tree is planted. Well shaped nursery grown trees should be selected and planted at a distance of from 30 to 60 feet apart, according to the variety. It is often the custom to cut off the entire top of the tree when planting. This is the greatest mistake ever made by the planter. A tree should be pruned when planted, but the proper pruning is only a thinning out or shaping back of side branches, leaving a straight leader in the center of the tree. When the tree is being dug for planting, it is absolutely necessary to save all of the fibrous roots possible and any of the large roots which may have been mutilated should be pruned back, so that a new growth will start. The most important of all when digging trees out is an immediate covering of the roots from the weather, to prevent drying up. More trees die from lack of this precaution than from any other cause. The drying winds and hot suns, so prevalent in many sections of the country, soon take the vitality out of the fibrous roots and the tree is unable to cope with the transplanting.

In planting a street tree, see that a large enough hole is dug to give the tree

Fig. 4. Cockspur Thorn (*Crataegus Crus galli*)

plenty of nourishment for growth in years to come. Ordinarily, holes five to six feet in diameter by three feet deep should be made for street trees, and good loam used for the entire planting. In planting, place the loose loam in the bottom of the hole, treading it firm and raising it so that it will be higher than the center and the proper height to have the roots of the tree not too deep. This will have to be done in accordance with the quantity of roots the tree has and, as a safe guide, a mark where the soil before touched the stem will be seen, and this should be taken as the place that should again touch the surface of the ground. In no case should the ground slope away from the tree when planting is finished. On the other hand, it is better that the ground should slope toward the tree. In filling in the hole, only fine loam should be put nearest the roots of the tree and as it is thrown in should remain firm, being tamped with a round tamper about the size of a pick handle, so as to make the soil firm over and through the roots. Make the soil firm among the roots and do not be afraid to thoroughly tamp.

Trees should be planted, in many locations, in the early spring and before the buds start into a new growth. On the other hand, fall planting will be found more advantageous to many of the varieties.

Much might be said regarding varieties and it is often a hard matter to settle which variety is the most suitable for a certain location. Some of the best varieties of trees for street planting are the
Platanus Orientalis (Oriental Plane tree)
Acer, Platanoides (Norway Maple)
Acer, Pseuda Platanus (Sycamore Maple)
Acer, Saccharinum (Sugar Maple)
Aesculus hippocastanum (Horse chestnut)
Catalpa Speciosa (Western Catalpa)
Quercus Rubra (Red Oak)
Quercus Palustris (Pin Oak)
Sorbus Aucuparia (European Mountain Ash)
Tilia Europea (European Linden)
Tilia Platyphillos (Broad-leafed European Linden)
Tilia Dasytyla (Crimean Linden)
Ulmus Americana (American White Elm)
Ulmus Campestris (English Elm)

Roses

In the planting of roses the selection of a good location is the first essential and it is better to keep them from shade and away from the roots of trees. Roses will thrive in any good soil. It has often been said that roses require a clayey soil. This has been proven however to be incorrect, as many of the best rose plants will be found growing in the gravelly and fine sandy soil. The soil however must be well enriched with plenty of decomposed stable manure, cow manure being preferable. The ground should have good drainage and should be loosened up to a depth of from 1½ to 2 feet.

Roses may be planted in the fall or before the ground freezes, or in the early spring before the growing season starts in. Care should be taken to spread the roots of the plants out evenly and the soil should be drawn firmly through the roots of the plant. When budded or grafted plants are used they should be planted at from three to four inches below the bud or graft, that is, where the rose is united to the stock. This is beneficial, as by so doing new roots are pressed from the base of the rose plant, thereby giving it increased strength and helping to prevent the growing of suckers from the briar on which the roses budded are grafted. The distance for planting may be varied according to the varieties planted, 18 to 24 inches being about the general distance for most varieties.

In some sections mulching will have to be done in the winter, to prevent the ground from heavy freezing and help protect the plants. This means the covering of the ground with five or six inches of coarse litter. Pruning should be done in early spring before the growth is started in the plants. Cut out as much as possible of the old wood; that is, wood that has flowered last year, leaving the strong shoots of last year's growth which should be cut back to from eight to 12 inches from the ground.

Fig. 5. Western Wild Rose (*Rosa arkansana*)

From these shoots the fairest flowers will be had.

Tea roses and hybrid teas should be pruned more lightly than the hybrids. Perpetuals, ramblers or climbing roses do not require much pruning. All that is necessary is the thinning out of the dead shoots. Roses require lots of cultivation during the growing season and the ground should be loosened up through the plants once a week, and when the watering is done, the ground should be well soaked, not sprinkled.

Insect pests may easily be kept from the rose plants; for the slug or worm which is found eating the leaves, hellebore powder dusted on the leaves will quickly destroy them. If the White Thrip appears, the ground will have been kept too dry and this may be gotten rid of by plenty of watering and syringing of the plants. For exterminating the aphis, frequent spraying with the hose will be found as effective as anything. For mildew, sulphate potassium in proportions of one pound to 40 gallons water will be found very satisfactory.

The number of species of Rosa is extensive and the popular varieties of today are hybrids of the many species from all parts of the world. The hardy garden roses have formerly been the hybrid perpetuals or more properly hybrid remontant—largely hybrids of Rosa Damascena, Borbonica, Gallica, etc., but within the last decade so much advancement has been made in the hybrid tea class that they have become by far the most popular of all garden roses.

The climbing roses are largely hybrids of Rosa Multiflora, Setigera and Wichuraiana, and so much improvement has been made in the latter hybrids during the last ten years, that no garden is complete without a number of varieties of them.

The Japanese roses, Rosa Rugosa, are hardy and of much value for natural plantings; their foliage is entirely distinct and during the latter part of the season their fruit is extremely ornamental.

On the American native roses, until recent years little value has been set unless it has been Setigera and Laevigata, both of which have been used in the hybridization of climbers.

There are a number of the native roses which have proven of great value in natural plantings of shrubbery in parks and other public grounds, among them being Rosa Lucida, Blanda, Nitida and Arkansana. The latter is perhaps the most valuable of any for this purpose.

Hybrid Perpetual Varieties

The list of varieties of this class contains only those which are of the most vigorous habit, though there are many others that may have been found of great value by some rose growers.

Abel Carriere—Rich, velvety maroon shaded with violet, large, full and finely shaped.
Alfred Colomb—Bright, clear red, large and full, form globular and excellent.
American Beauty—Rosy crimson.
Anna de Diesbach—Clear rose.
Baron de Bonstettin—Red, black and crimson.
Baroness Rothschild—Pale rose shaded with white.
Beauty of Waltham—Rosy carmine.
Belle Siebrecht
Captain Christy
Captain Hayward—Crimson-carmine.
Charles Lefebvre—Bright crimson.
Clio—Flesh color.
Duke of Edinburgh—Scarlet-crimson.
Eugene Furst—Velvety-crimson.
Fisher Holmes—Reddish scarlet.
Francois Michelon—Deep rose.
Frau Karl Druschki—Snowy white.
General Jacqueminot—Brilliant red.
George Arends—Pink.
Hugh Dickson—Brilliant crimson.
John Hopper—Rose, crimson center.
Jules Margottin—Bright cherry.
Lady Helen Stewart—Crimson-scarlet.
Madame Gabriel Luizet—Pale pink.
Madame Victor Verdier—Bright cherry.
Magna Charta—Bright pink.
Margaret Dickson—White with pale flesh centers.
Marie Baumann—Bright carmine.
Merveille de Lyon—Pure white.
Mrs. John Laing—Soft pink.
Mrs. R. G. Sharman Crawford—Deep rosy pink.
Paul Neyron—Dark rose.
Pride of Waltham—Delicate flesh color.
Prince Camille de Rohan—Crimson-maroon.
Tom Wood—Cherry-red.
Ulrich Brunner—Bright cerise-red.
Victor Verdier—Rosy carmine.

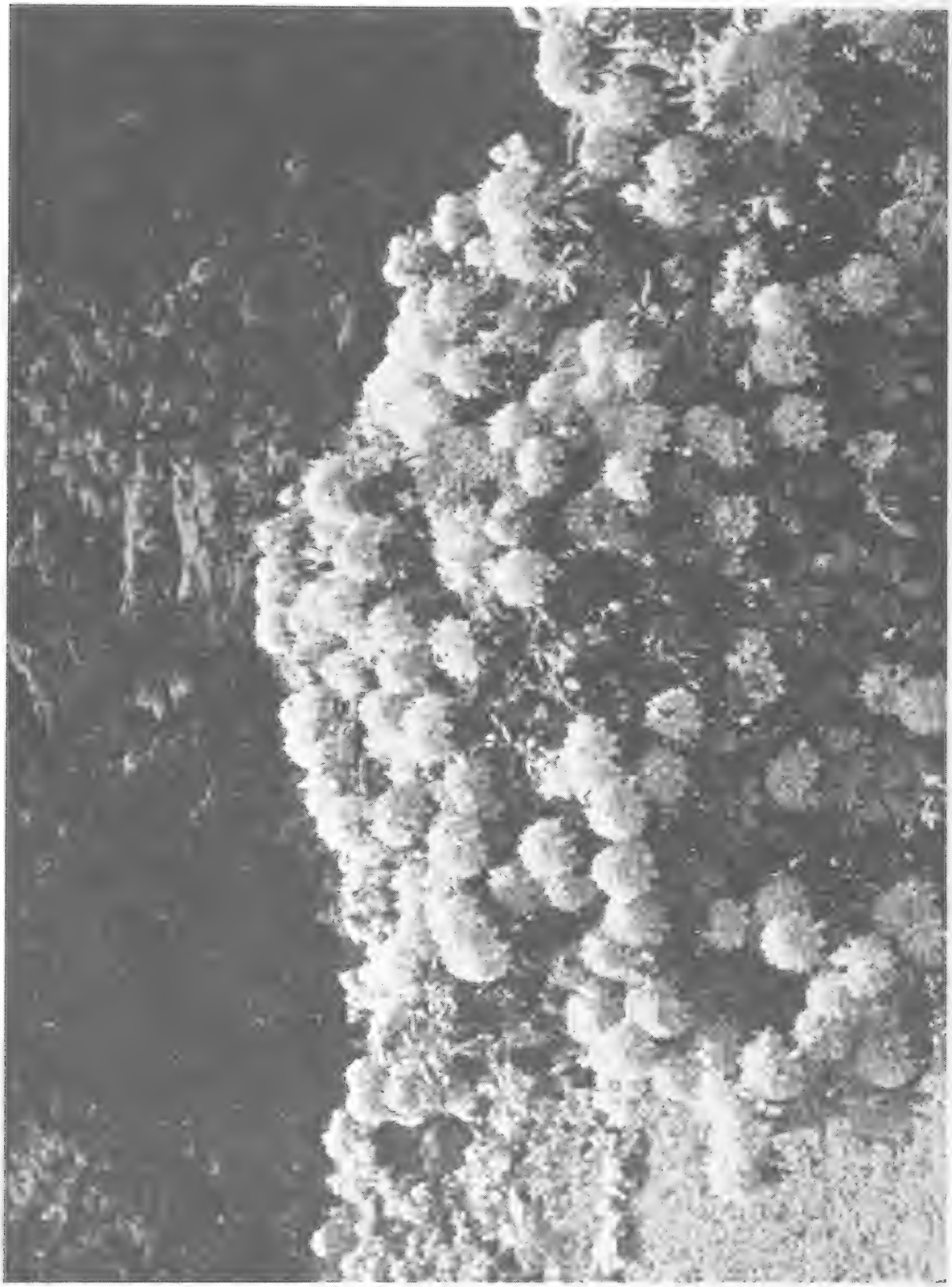


Fig. 6. Hybrid Rhododendron.

Teas and Hybrid Teas

The most of the varieties enumerated are the hybrid tea varieties and are the most popular of all garden roses on account of their continuality of bloom throughout the season. Some tea varieties require protection unless in well sheltered locations.

Arthur R. Goodwin—Coppery orange-red.
Augustine Guinoisseau—Rosy white
Belle Siebrecht—Rosy pink.
Betty—Coppery rose, shaded yellow.
Caroline Testout—Clear rose.
Countess of Gosford—Salmon pink.
Countess of Shaftsbury—Silvery carmine.
Cynthia—Lemon-yellow.
Cynthia Forde—Rose-pink.
Dean Hole—Carmine shaded with salmon.
Dorothy Page Roberts—Coppery-pink suffused apricot yellow.
Duchess of Albany—Deep pink.
Duchess of Wellington—Saffron-yellow.
Earl of Warwick—Salmon pink.
Edward Mawley—Velvety crimson.
Elizabeth Barnes—Salmon-rose, fawn center
Etoile de France—Crimson, center fiery red.
General MacArthur—Scarlet-red.
George C. Waud—Vermilion tinted orange.
Gruss au Teplitz—Cinnabar-scarlet.
Instituteur Sirdey—Golden yellow.
Irish Fireflame—Orange splashed crimson
Jonkheer J. L. Mock—Red and salmon-pink.
Kaiserin Augusta Victoria—Pure white.
Killarney—Rose color.
Konigan Carola—Satiny rose flowers.
La France—Pale peach rose center.
Lady Alice Stanley—Coral rose.
Lady Ashtown—Pale rose.
Laurent Carle—Velvety-carmine.
Liberty—Brilliant crimson.
Lyon Rose—Buds coral red, flowers shrimp pink shaded coral red and chrome yellow.
Mabel Drew—Cream.
Madame Abel Chatenay—Rosy salmon, carmine.
Madame Ravary—Golden yellow, open flowers nankeen yellow.
Madame Segond Weber—Bright salmon-rose
Margaret Molyneux—Saffron yellow.
Marquise de Sinety—Carmine-ochre
Melody—Saffron yellow with primrose edges.
Mildred Grant—Blush-white tinted with pink.
Mrs. Aaron Ward—Indian yellow.
Mrs. A. R. Waddell—Rosy scarlet buds opening reddish salmon
Mrs. David Jardine—Bright rosy pink.
Mrs. Wakefield Christie-Miller—Pearly blush
Pharisaer—Rosy-white, center deep salmon-rose.
Prince de Bulgarie—Silvery-flesh.
Rayon de'Or—Cadmium-yellow.
Richmond—Reddish-scarlet.
Souvenir du President Carnot—Rosy flesh.
Viscountess Folkestone—Creamy-pink.
White Killarney—White.
William R. Smith—Creamy white shaded with pink.

Provence Roses

Rosa centifolia

Cabbage or Common—Rosy pink.
White Provence—Pure white.

Moss Roses

Blanche Moreau—Pure white.
Countess de Murinais—White.
Crested Moss—Rose color.
Crimson Globe—Crimson.
Gloire de Mosses—Blush.

Austrian Briar Roses

Rosa lutea

Austrian Copper—Coppery red (single).
Austrian Yellow—Yellow (single).
Harrisonii—Golden Yellow (semi-double).
Persian Yellow—Deep golden yellow

Japanese Roses

Rosa rugosa

Belle Poitevine—Rose color.
Blanc Double de Coubert—Double white.
Conrad F. Meyer—Silvery-rose.
Delicata—Soft rose.
Madame Georges Bruant—Paper white
Repens alba—Flowers single white.
Rugosa—Crimson.
——— Alba—White

Wichuraiana Roses and Their Hybrids

Alberic Barbier—Yellow buds, opening creamy white, double.
American Pillar—Flowers single; rich pink with a well defined white eye and yellow stamens.
Bonnie Belle—Single pink flowers with yellow stamens.
Coquina—Flowers single, pale pink shading deeper at the tips of the petals.
Dorothy Perkins—Large clusters of rich, soft rose color.
Evangeline—Single flowers, white shaded.
Excelsa—Brilliant scarlet-crimson.
Gardenia—Bright yellow in bud, changing to cream as the flowers open.
Hiawatha—Single bright rich crimson with white eye.
Joseph Lamy—Porcelain white tinted pink.
Kalmia—Pink with white center, single.
Lady Gay—Pink double.

Milky Way—Single white with yellow stamen.
Minnehaha—Deep satin rose, double.
Mrs. M. H. Walsh—Snow-white
Pink Roamer—Pink flowers with silvery white centers.
Sweetheart—Pale pink.
White Dorothy Perkins—White.
Wichuraiana—Type of the group; pure white.

Multiflora Roses and Their Hybrids

Aglaia—Canary yellow flowers.
Blush Rambler—Single flowers; blush.
Crimson Rambler—Crimson flowers.
Fairy—Snow-white.
Flower of Fairfield—Crimson rambler.
Leuchtstern—Bright rose, distinct white eye.
Newport Fairy—Single pink flowers with white eye.
Philadelphia Rambler—Crimson rambler bright in color.
Queen Alexandra—Crimson.
Rubin—Ruby-red.
Tausendschon—Soft pink to carmine rose.
Thalia—Double white.
The Dawson Rose—Pale rose.
Veilchenblau—Bluish purple.
Wedding Bells—Rosy pink.

Sweet Briars

Anne of Gierstein—Dark crimson.
Brenda—Blush or peach.
Lady Penzance—Beautiful soft copper.
Lord Penzance—Soft shade of ecru.
Meg Merrilies—Crimson.
Refulgence—Semi-double flowers, scarlet.

ROSE DISEASES

Black Spot

Actinonema rosae

Produces purplish or discolored areas of considerable size on the surface of the leaves, causing them to drop.

See *Mildew*, this section.

Cane Blight

Affected wood turns a dark purplish or black color, with a sharply defined line between the sound and diseased bark.

This trouble is due to a fungus which is apparently undescribed in plant disease literature. It infests stubs left in pruning and often develops down into the main branches, seriously injuring the bushes.

May be largely avoided by proper pruning.

Crown Gall

This is the common crown gall which affects many species of plants.

See under *Apple Diseases*.

Rose Leaf Blotch

Actinonema rosae (Lib.) Fr.

Nearly as common as the powdery mildew. Irregular brown spots appear on the upper surface of the foliage.

Climbing sorts are likely to be more immune than bush kinds.

Spray with Bordeaux early before blossom buds begin to form. Secure healthy stock for planting.

Reference

Duggar, Fungus Diseases of Plants.

Rust

Phragmidium subcorticium

Affects the hybrid roses, causing the leaves to turn yellow and fall, with black or bright orange pustules of rust spores on the under side.

See *Mildew*, this section.

Mildew

Sphaerotheca pannosa and *S. humuli*

Roses are commonly affected with two different powdery mildews quite different in appearance from one another. The first named is seen most characteristically on the hybrid roses and is particularly severe on the Crimson Rambler. It forms a thick, dense, felty white growth upon the green shoots, buds, and young leaves more than on the surface of the older leaves. This does not affect the tea roses. The latter are particularly susceptible, however, to the second fungus named, which produces a more delicate fungus growth upon the leaves and blossoms rather than the stems, giving them a crinkled appearance.

The most effective treatment for these rose troubles consists in spraying the bushes occasionally with a solution of sulphide of potash (liver of sulphur), one ounce to three gallons of water. Spray the under side of the leaves as well as the top and make up the solution fresh each time the spraying is done. If the bushes are also affected with plant lice an addition of tobacco extract or cheap soap may be made to the spray. In bad cases of mildew further relief may be obtained by dusting the bushes thoroughly with flowers of sulphur while they are still wet with the spray.

Different varieties vary greatly in susceptibility, and the ordinary grower will find the most satisfaction by discarding the most susceptible kinds and growing others which are less liable to disease.

R. E. SMITH,
Calif Exp. Sta Bul. 218.

References

California Experiment Station, Bulletin 218.

Duggar, Fungus Diseases of Plants.

ROSE PESTS

Large Rose Aphid

Macrosiphum rosae Linn

General Appearance

A large aphid, being green and pink in color. The apterous forms have dark cornicles and the joints of the legs and antennæ dusky, while in addition to these the thorax, entire antennæ and blotches on the sides of the abdomen of the winged forms are dark. Length, two to three mm. Readily distinguished from the other common green rose aphid by the large size and pink forms.

Life History

Works on the young shoots and buds of the roses, almost throughout the entire year. Especially troublesome in the early spring during the months of April and May. Not so serious a pest on roses as is the small green louse (*Myzus rosarum.*)

Food Plants

Roses, wild and cultivated.

Control

In order to save the buds it is sometimes necessary to spray the bushes with a soap and tobacco spray. Washing the bushes every day with a high pressure of water will keep them off and is a practical method of control.

Natural Enemies

Natural enemies completely eliminate the attacks of this pest by the middle of summer.

Fuller's Rose Beetle

Aramigus fulleri Horn. (Family Otiorhynchidæ)

General Appearance

The adults vary from gray to very dark brown in color and from three-eighths to one-half an inch in length. The eggs are about one-twentieth of an inch long, pale yellow and laid in rows. The larvæ are milky white and without legs. The pupæ are also white.

Life History

The eggs are laid in clusters in secluded places on the trunks of trees or at the base of the trees or plants often close to the ground. The young white grubs are subterranean in their habits, doing great damage to the roots of many plants. The adults when seen during the day are very sluggish. They have no power of flight. Much damage is done to plants by this pest unknown to the farmer, owing to the fact that the larvæ work underground and the adults feed at night.

Food Plants

Foliage of citrus trees, roses, oaks, camellias, palms, *Canna indica* and the roots of strawberries. Young or newly budded citrus trees are often greatly damaged by this pest.

Control

The larvæ, like all subterranean pests, are difficult to control, but thorough cultivation and hoeing close to the plants are great aids. In light sandy soil, carbon bisulfid is efficient. The adults being unable to fly are easily kept from trees by means of a cotton or tanglefoot band around the trunk, but are very troublesome to low plants and bushes where such methods are impracticable. Poison sprays such as arsenate of lead must be resorted to in such cases to save the foliage.

E. O. ESSIG

RASPBERRY HORN TAIL. See *Raspberry Pests*.

Rose Scale

Aulacaspis rosae Bouche.

General Appearance

The female scales are nearly circular with very irregular edges and white to gray in color with reddish body. This scale multiplies very rapidly and clusters in great numbers on the stems of roses and kindred plants, especially about the crowns.

Somewhat difficult to control. Badly infested canes should be cut out and burned.

Spray with kerosene or carbolic acid emulsion or lime-sulphur during the winter.

Reference

Monthly Bulletin California Commission of Horticulture II., 1 and 2.

Rose Snout Beetle

Rhynchites bicolor Fab. (Family Rhynchitidæ).

General Appearance

A small bright red snout beetle, with head, snout and legs black. The average length of the females is about one inch. The males are noticeably smaller than the females.

Life History

The beetles hibernate over winter in sheltered places and appear early in the spring. The females roll up the edges of the leaves into small pockets like miniature thimbles into which the eggs are laid and the young reared. The larvae and adults feed upon the foliage, the latter also puncturing the fruit of blackberries and raspberries with their snouts or bills.

Food Plants

The beetles confine their attacks almost wholly to the wild rose, though they may occasionally work great damage to cultivated roses and to berries. The adults also feed upon oak leaves and grapevines.

Control

As this pest is normally a leaf eater it may be controlled by liberal applications of arsenical sprays. These meet all requirements, except where they damage the fruit of berries, but even such attacks could have been prevented by spraying the vines before the berries began to ripen.

E. O. Essig

Small Green Rose Louse

Myzus rosarum Walk

General Appearance

A very small species, not nearly as large as *Macrosiphum rosae*; green throughout except dark markings on the winged forms. It is often mistaken for the larger species

Life History

A very serious rose pest at times, and especially bad in the summer months. It breeds very rapidly, collects in great numbers upon the leaves and excretes a great amount of honeydew which smuts the bushes. The worst rose pest in many parts of the state.

Food Plants

Roses, usually more serious on climbing varieties. Attacks the leaves and buds and may prevent the production of flowers

Natural Enemies

Syrphid flies do considerable work upon this species, but the natural enemies are not numerous enough to check the ravages until late in summer.

E. O. Essig

Other Insect Enemies

The rose is attacked by various insects which are common to fruit trees. Among them are San Jose scale, greedy scale, oyster-shell scale, red spider, apple-leaf hopper, etc. These will be found treated under *Apple Pests*. Frosted scale will be found under *Prune Pests*.

LANDSCAPE GARDENING

By John W. Duncan

Landscape gardening covers a broad field and considerable study, taste and judgment are required on the part of those who undertake the business. Landscape gardening of the best order is the beautification with as little change as possible from what nature has already done. Mere planting and grading does not constitute landscape gardening and the proper grouping or clustering of shrubs and trees make really the most picturesque landscapes. Some of the best landscape scenes are found in this Western country and there is a wide field here for the artificial gardener. The great wealth of native trees, shrubs and other plants found all over this section of the country adds greatly to the work and simplifies the problem. A general theory or plan is necessary before there is any grading or planting, as it is necessary to work out the whole from the well studied out plan which should be made in the beginning.

The indiscriminate growing of shrubs or plants often spoils a beautiful land-

scape and the inherent love of nature is absolutely necessary to the best success of a landscape gardener, who must also be familiar with all varieties of trees, shrubs and other plants, besides having a thorough knowledge of grading, draining, road building and the like. Care should also be taken to avoid scattered effects. The best planting of trees and shrubs is accomplished by the grouping of the suitable varieties which can only be decided by a thorough study of the location.

Single or individual trees or plants may be used to heighten an effect. It is best always to widen out or leave as much open land as possible. Walks and drives are necessities and therefore should be hidden as much as possible from the landscape. Where there are buildings, the grounds must conform to them and it is a problem to work out the best possible plantings, so that these buildings will not occupy the most prominent part of the landscape picture. Obtrusive or undesirable features should be hidden by the artificial planting of trees and shrubs. Natural plantings should be adhered to as much as possible and the planting of different trees should be carefully studied so that when they have attained their growth they will accomplish the purpose for which they were intended.

Avoid as much as possible the making of designs or the planting of trees or hedges which will constantly require cutting or pruning into shapes which do not agree with nature. The variety of trees and shrubs should be restricted to those that are perfectly hardy and that will adapt themselves to the locality.

In the planting of a large space it is well to have as much open expanse as possible, so as to produce a wide landscape effect. The tall growing trees should be kept in the background with the dwarfer growing varieties in front graduating to irregular belts of shrubs, so that one may look over the foreground to an irregular background of the larger trees behind.

The best decisions of the varieties to

Fig. 7. Japanese Snowball (*Viburnum plicatum*)

use may always be made during the summer when the different deciduous and evergreen subjects may each and all be readily seen to the best advantage, when their leaves are fully expanded. At such times, too, any defects may be noted for remedying at some later period.

Conifers and all evergreen trees may be used to good advantage and should be, where plenty of space is available, planted in large groups, so as to avoid a patchy appearance. Consideration should be given to the location of summer trees with particular individuality, so that they can show the same to the best advantage during the whole of the season. Again, many of the trees or shrubs which have different color of bark or foliage should be grouped so that they will emphasize their particular feature and the particular season at which these features may show to the best advantage.

A water effect is one of the most pleasing and almost essential features of a fine landscape, whether it is a lake or river effect; either will go a long way toward the effectual natural planting and making of a fine landscape. Many times good effects can be worked out by utilizing springs or small rivulets where there were practically no water effects formerly. In water scenes, the judicious planting of trees and shrubs on the borders or islands will greatly enhance the natural landscape and many water plants may be introduced to make the effect more gardenesque.

In the planting of small estates or home grounds, the mistake generally made is the scattering too much of the trees and

Fig. 8. Viburnum pubesceus.

shrubbery through the lawn, as already mentioned. The finest effects can be made by the judicious border planting, leaving as much open space forming vistas from the house piazza or views from the various windows, so that the grounds will, in reality, look much larger than they really are.

History and General Principles of Landscape Gardening

L. P. Jensen

History

The history of the gardens of the ancients is more or less fabulous.

The Jewish paradise is supposed to have been situated in Persia, of great extent, watered by a river and abounding in timber and woods. Paradise seems to have borne some resemblance to a pleasure ground of the modern taste The gardens of the Hesperides were situated in Africa near Mt. Atlas, or according to some, near Cyrenaica. They are described as lying in places eighteen fathoms deep, steep on all sides, two stadia in diameter and covered with trees of various kinds planted very close together. The principal Jewish garden was King Solomon's. This garden is said to have been quadrangular and surrounded by a high wall. It contained a variety of plants, such as "the hyssop which springeth out of the wall," odoriferous and showy flowers as the rose, lily of the valley, calamus, camphire, spikenard, saffron and cinnamon; trees as the cedar, pine and fir, and fruits, as the fig, grape, apple and pomegranate. It contained water in wells, and in living streams. The situation of the garden was probably near to the palace

The gardens of Cyrus, at Babylon, 2,000 years B. C., were of square form and according to Strabo, each side was 400 feet in length, so that the area of the base was nearly four acres. They were distinguished by their romantic situations, great extent and diversity of uses and were reckoned in their day among the wonders of the world. They were made to rise with terraces constructed in a curious manner one above the other in the form of steps, and supported by stone pillars to a height of more than 300 feet, gradually diminishing till the area of the upper surface was reduced considerably below that of the base. The garden of the Phacacian King, Aelianus, was situated on the island of that name, probably an Asiatic island. It is minutely described by Homer in his "Odyssey," and may be compared to the garden of an ordinary farm house in point of extent and form, but in respect to variety of fruits and vegetables was far inferior It embraced the front of the palace, containing less than four acres surrounded by a hedge and interspersed with three or four sorts of fruit trees, some beds of vegetables and some borders of flowers. It contained two wells, one for the garden, and the other for the palace.

The Persian and Grecian gardens of this period seem to have been nearly of the same description as those mentioned

We know little of the gardens of the Augustan age of Horace and Virgil, generally thought to be that in which taste and elegance were eminently conspicuous. From the descriptions of the villas Laurentinum and Thusculum, by the younger Pliny, we gain a general idea of the gardens of the Romans. The Laurentinum was a winter residence on the Tiber, between Rome and the sea, now called San Lorenza, seventeen miles from Rome. The garden was small and is but slightly described. It was surrounded by hedges of box and rosemary, and there were platforms and terraces; figs, mulberries and grapes were the fruits. Pliny's Thusculan villa was situated in a natural amphitheater of the Appenines whose lofty summits were clothed with forests of oak and their fertile sides covered with cornfields, vineyards and villas. Pliny's description of this villa is of importance as showing what was esteemed as good taste in the gardens and grounds of a great Roman nobleman of the first century, under the reign of Trajan, when Rome was still in her glory.

The Thusculan gardens may have contained from three to four acres and lay around the palace. The terrace is described as in the front of the portico and near the house; from this descended a

Fig. 9. Black Haw (*Viburnum primufolium*)

lawn covered with acanthus, supposed to have been a sort of moss and adorned with figures of animals cut in trees. This lawn was again surrounded by a walk enclosed with evergreens sheared into a variety of forms. Beyond this was a place for exercise ornamented in the middle with box trees sheared as before into numberless different figures, together with a plantation of shrubs kept low by clipping. The whole was fenced in by a wall covered with box, rising in different ranges to the top. Another quarter of the house compassed a small space of ground, shaded by four plane trees with a fountain in the center, which, overflowing a marble basin, watered the trees and the verdure beneath them. Opposite to another part of the house was a plantation of trees in the form of a hippodrome, formed of box and plane trees alternately planted, and connected together with ivy. Behind these were placed bay trees and the ends of the hippodrome, which were semi-circular, were formed of cypress. The internal walls were bordered with rose trees and were in a winding direction, which, however, terminated in a straight path, which again branched into a variety of others separated from one another by box-hedges. These were sheared into a variety of shapes and letters, some expressing the name of the master, others of the artificer, while here and there small obelisks were placed intermixed with fruit trees, sheared as already described. At the upper end of the garden was an alcove of white marble, shaded by vines and supported by marble pillars, from the seat of which recess issued several streams of water intended to appear as if pressed out by the weight of those that reposed upon it, which water was again received in a basin so contrived as to seem always full without overflowing. Corresponding to this was a fountain that threw water to a considerable height and which ran off as fast as it was thrown out. An elegant marble summer house, opening into a green inclosure and furnished with a fountain similar to the one last described, fronted the above. Throughout the walks were scattered marble seats, near to each of which was a little fountain and throughout the whole, small rills of water were artificially conducted to entertain the ear with their murmur as well as to water the garden.

It will be seen later that the garden of Pliny had a striking resemblance to the French and Dutch style of gardening of the 16th and 17th centuries. After the fall of the Roman Empire little is known of the art of gardening up to the beginning of the 16th century when it was revived by the Medici family in Rome. These gardens were geometrical designs and served as models for other famous gardens which succeeded them until the change of taste in gardening in England about 1760.

The so-called Dutch or Holland style differs but little from those already mentioned. At the end of the 16th century the French began to copy the gardens of the Italians, and during the reign of Louis XIV, 1651-1715, Le Notre improved and settled the French style in his laying out of grounds and gardens. His taste and style continued in full repute for upwards of a century. Hirchfeld, in his "Theorie der Gartenkunst," Vol. 1, 1779, observes that "if Le Notre had been born under any other monarch than Louis XIV, his taste would in all probability never have spread nor his name been known to posterity. But that age in which a feeling for the fine arts had begun to awaken in men's minds, together with the personal character of this monarch, was favorable to pomp and brilliancy. The nation and the court wished to be dazzled and enchanted by novelty and singularity; and though there certainly was nothing in Le Notre's manner that had not before been displayed in France and Italy and with the exception of parterres, even by the Romans, yet the grand scale and sumptuous expense of the plans surpassed everything before seen in France, and produced precisely the desired end. His long clipped alleys, triumphal arches, richly decorated and highly wrought parterres, his

fountains and cascades with their strange ornaments, his groves full of architecture and gilt trellises, his profusion of statues, all these wonders, springing up in a desert-looking open country, dazzled and enchanted every class of observers." The principal works of Le Notre are Versailles, which cost nearly 200 million francs, Trianon, St. Cloud, Chantilly, and the celebrated terrace of Saint Germain. He went to Italy and England, and the rest of Europe adopted his style. He died in 1700.

The Romans abandoned England to the Saxons in the beginning of the fifth century and the art of gardening, which had revived in France under Charlemagne, was probably introduced into England at the end of the eleventh century. During the following centuries, until after the hundred years of dispute between the houses of York and Lancaster, we find little or no record of gardening until the time of Henry VIII. when the royal gardens of "Nonsuch" were laid out. These gardens were said to have been cut and divided into several alleys, quarters and rounds, set about with thorn hedges. On the north side was a kitchen garden surrounded by a wall

Fig. 10. White Fringe (*Chionanthes virginica*)

14 feet high; on the west was a wilderness containing ten acres. In the gardens were pyramids, fountains and basins of marble, one of which was set round with six lilac trees. Besides the lilacs there were 144 fruit trees, two yews and one juniper; in the kitchen garden were 72 fruit trees and one lime tree; lastly, before the palace was a neat bowling green, surrounded with a balustrade of strong stone. This was in the year 1650.

Lord Francis Bacon attempted to reform the national taste in gardening during his time, but apparently with little immediate success. He wished still to retain the shorn trees and hedges, but proposed winter or evergreen gardens and rude or neglected spots as specimens of wild nature. "As for the making of knots and figures," said he, "with divers colored earth, they be but toys. I do not like images cut out in juniper and other garden stuff, they are for children." Sir Henry Wotton said the garden at Lord Bacon's was one of the best he had ever seen, either at home or abroad. It is allowed on all sides that Joseph Addison and Alexander Pope prepared for the new art of gardening the firm basis of philosophical principles. Addison had a small retirement at Bilton, laid out in what may be called a rural style. Pope attacked the verdant sculpture and formal groves of the ancients with the keenest shafts of ridicule, and in his "Epistle to Lord Burlington," laid down the most just principles of art, the study of nature, of the genius of the place, and never to lose sight of good sense.

But it was reserved for William Kent to carry their ideas more extensively into execution. It was reserved for him to realize the beautiful descriptions of the poets for which he was peculiarly adapted by being a painter as the true test of perfection in landscape gardening is that a painter would choose it as a composition. Kent was born 1675 and died 1748. Kent was succeeded by Launcelot Brown. Brown was bred a kitchen gardener, but was afterwards head gardener at Stowe. He was extensively employed by the nobility. His new plantations were generally void of genius, taste and propriety. His creations were all surrounded by a narrow belt, and the space within was distinguished by numbers of round or oval clumps, and a reach of one or two tame rivers on different levels. This description in short will apply to almost every place in England laid out from the time about 1740, when the passion commenced for new modeling country seats, to about 1785 or 1790, when it, in a great measure, ceased. The leading outline of this plan of improvement was easily recollected and easily applied. The great demand produced abundance of artists and the general appearance of the country so rapidly changed under their operation that in the year 1772 Sir William Chambers declared that if the mania were not checked in a few years longer there would not be found "three trees in a line in the entire country." This system was, in fact, more formal than the ancient style, which it succeeded, because it had fewer parts. The ancient gardens had avenues, alleys, platoons, circular masses, rows double and single, all from one material wood, but the new style, as then degraded, had only three forms, the clump, the belt and single tree.

The good sense of the country soon revolted at such monstrous productions, and proprietors were ridiculed for expending immense sums in destroying old gardens, avenues and woods, and planting in their place young clumps for no other reason than that it was the fashion to do so. The writers who ventured to protest were principally: George Mason, in his "Design in Gardening," 1765; William Sheustone in "Unconnected Thoughts on Gardening," 1764; Whately in "Observations on Modern Gardening," 1771; William Chambers in "Dissertation on Oriental Gardening," 1772; William Mason, the poet, in "The English Garden," 1772-1789; and especially the writings of Richard Paine Knight, Sir Uoedale Price and Rev. William Gilpin, 1780-1800.

The change of taste in gardening seems to have been materially aided by accounts of Chinese gardens, about the end of the

17th century. According to these descriptions, the Chinese gardens were laid out in the natural style.

The gardens of Japan are original and unique. The Japanese landscape gardener studies a natural landscape and reproduces it in miniature, his composition including mountains, lakes, streams, hills and woods. While these gardens are often very small, they are artificially arranged, and for this reason well worthy of study, as the principles employed may be utilized in the laying out of ground on a larger scale.

Fig 11. Dwarf Mountain Pine (*Pinus monticola*)

Humphrey Repton was the first who took unto himself the title of landscape gardener and the first to lay down fixed principles for the art. His published works are still indispensable to the landscape gardener. His career as a professor began about 1788. The elegant, sensible style soon rapidly spread over continental Europe and was introduced into America by Andrew Parmentier, who came here from Belgium about 1824. He was followed by Andrew Jackson Downing, whose "Landscape Gardening" and "Letters to the 'Horticulturist,'" are well known to have greatly assisted the advancement of landscape art in America. But the one who carried the art to its highest point was Frederick Law Olmsted. His writings are classics on outdoor art, and his work in designing parks and other grounds were object lessons which have paved the way for the wave of interest in landscape gardening and civic improvement, which is now becoming general throughout the country.

General Principles

The naturalistic methods of gardening are undoubtedly the most interesting to the American people, and I think the formal arrangement should be confined to restricted areas, disconnected from the other parts of the ground. In connection with magnificent architecture and considered as part of the architectural scheme, this kind of gardening is perfectly fitting.

The aim of the landscape gardener is the formation of pictures and the principles governing his works are the same, whether he is working on a large park or on the area of a city lot. The materials are earth, rocks, woods and water. The buildings, roads and walks are artificial features necessary for the comfort and convenience of man.

The first step in the arrangement of any landscape is the making of a plan. This plan should give every detail of grading and planting arrangement It should be made to a scale large enough if possible to give the location of each individual plant. It should show the location of buildings, roads, paths, drains and all existing and proposed features. This plan should be accompanied by written instructions and specifications, and it should be conscientiously followed as a guide in future operations to prevent incongruities and confusion.

The laying out of the ground should be done in the following order: Locating and building the residence and other structures, grading, laying drains, making roads and paths, planting of trees and shrubs, and lastly, the finishing of the lawn. The location of the residence and the planting near it should be very carefully considered. Generally the house is finished and the grading done before the laying out of the grounds is thought of, whereas the proper way is to consider the location of the building in connection with the planning of the grounds. Planting about the base of a building helps to connect it with the lawn upon which it stands and softens the stiff, regular lines. This planting should consist of hardy material, which will be effective, even in winter.

Porches and parts of the building ought to be planted with hardy vines for purposes of both privacy and comfort. The lawn should be as spacious as possible to give extent to the place, and should have boundaries of closely planted trees and shrubs in irregular masses, the foreground of which may be planted here and there with masses of herbaceous and annual flowers carefully arranged so as not to cause a spotted effect.

Outbuildings should be partially screened by mass plantings so as to show only those parts of them which will add to the beauty of the composition. Avoid the common fault of scattering plants all over the grounds without reason or thought.

In the arrangement of the plantation be careful to study the natural growth of the plants such as height, form, rapid or slow growth, texture and color of the foliage and season of bloom. While most plants have green leaves there are great differences in the shades of green, which differences must be carefully considered

Fig. 12. White Spruce (*Abies alba*)

for the sake of harmony in the landscape composition.

Such plants as the blue spruce, purple beech, plum and birch, golden elder and all plants with highly colored leaves, should be used very carefully, as should also many of the plants like the weeping mulberry, weeping elm and the Kilmarnock weeping willow.

Take advantage of the beautiful points in the surrounding landscape by opening vistas and plant tall growing trees and shrubs, to shut out undesirable objects.

When planting groups and masses, do not indiscriminately mix the plants. Plant several of each kind or variety together, and where more than one kind are used in a group, let them mix slightly to avoid the formation of stiff, regular lines.

The proper location of drives and walks is an important consideration. They should be as direct as possible and planned for convenience as well as beauty. Except on very small places, a slightly curving road or walk is generally more pleasing than a straight one. Every road or walk should have a distinct aim, such as buildings, pleasing view points, etc. Large bends will only be justified by natural obstacles, such as rocks, water, or groups of trees The curves should be easy, and gracefully follow the natural contour of the ground. If possible, do not allow roads and walks to run through the center of an open lawn or meadow, but keep them to one side and plant trees and shrubs irregularly along their sides in such manner as to prevent long stretches of either road or walk from being seen from any point of view.

The entrance to a place should be as simple as possible, and in keeping with the general lay of the ground. Water is one of the most effective features in the landscape, and should be introduced whenever possible. The pond and lake give a peacefulness to the scene not otherwise easily acquired, and the rippling brook and the waterfall enliven the woods with their murmurs, the former never resting as it runs along from shadow to sunshine. The planting of the margins of streams and lakes gives an opportunity for introducing a great variety of plants which could not otherwise be grown, such as water lilies, cat-tails, calamus, Japan iris, and scores of other moisture-loving plants. The making of artificial ponds and lakes and the planting of them to fit natural surroundings is vastly more difficult than the arrangements of ordinary ground surfaces. They are apt to be made stiff and formal in their outline, examples of which are to be found in abundance in our parks and pleasure grounds.

A good way is to study Nature's arrangement, noting carefully how she goes about the formation of her duties, the obstructions in the streams causing the formation of natural dams, and how she forms her islands in streams and lakes. One may thus gain much valuable information, and by following it he will be able to make and plant the natural water features of his garden.

Bridges should be of a pleasing, simple design, harmonizing with their surroundings. No bridge should be built unless there is a reason for it. Other structures, such as summer houses, arbors and boat houses, should be very carefully placed. If the design is simple and in harmony with its surroundings, the structure may add materially to the beauty of the landscape, but if not properly designated or placed without apparent reason for its position, it had better be left out, as it would only spoil what perhaps otherwise was a fine composition.

In the planting of the naturalistic garden or landscape, we should mainly rely on plants of undoubted hardiness, and for this reason our native plants are splendidly adapted. We have a wealth of native material in our woods, fields and meadows, suited to every locality, soil and condition. Nature is the best teacher. Get acquainted with the native material first, then visit as many good gardens as possible and learn how to use this material to the best advantage.

Do not try to grow such plants as love shade and moisture on dry hillsides, as is often done, but select plants which are especially adapted to the climate, soil and situation of your garden. Use American grown plants in your plantations if you want to succeed. Do not attempt to transplant large trees and shrubs from the woods into your gardens, they will either not live or produce a stunted growth. Small plants may be collected and transplanted successfully.

Make use of the many beautiful hardy plants introduced from other countries, especially those from Japan which are well adapted to our American climate. These, as well as our native plants, can be obtained from our American nurseries, where they have had the care necessary for successful transplanting.

FLOWERS

Most of the flowers treated in this work will be found catalogued in this section, and not as generally treated in the alphabetical order of names scattered through the work. The Standard Dictionary gives the following definition of "flower":

"Botanically, a flower may be regarded as a sporangia (spore-case) bearing shoot, or sporophore. Only two parts are essential, the androecium (male part) and the gynoecium (female part), these organs being necessary to the production of seed. But not all seed-bearing plants produce flowers in the popular meaning of the term, the conifers and their allies being considered flowerless. As ordinarily used, the term flower refers to those floral structures whose sporangia-bearing leaves are made conspicuous and are protected by colored leaves. Even when the sporangial leaves are absent (as hydrangeas and chrysanthemums) the clusters of colored leaves are called flowers. A flower in its simplest form may consist of only an axis that bears a single sporophyl. The opposite extreme may be seen in certain composites and orchids that possess complex and highly specialized floral structures, the differentiations having arisen apparently to aid the more easy transfer of pollen or the more effective scattering of seeds. A completely developed flower consists of a central short stem (torus), floral leaves (sepals,

Fig. 13. Evergreen Hedge, Eastern Hemlock (*Tsuga canadensis*)
—*Photo by Duncan.*

petals), and sporangial leaves (stamens, carpels). These parts vary in number in different plants. True flowers are produced only by the higher vegetable organisms. Double flowers are developed by increasing the floral leaves at the expense of the sporangial ones, as the snowball."

Floriculture was not an important industry until about 100 years ago. Previous to that there was not a comparatively great effort to beautify the homes or to make floriculture an important commercial industry. This probably grew out of a number of facts. First, when people are struggling for subsistence and the struggle is severe, they have little time to devote to beautifying their homes, and the energy of life is directed toward obtaining those things that are necessary in order to live. Second, when society in general has accumulated but little money and there are few wealthy people, not much money can be invested in flowers or luxuries of any kind. Third, under these conditions society would lack that cultivated taste which would lead it to devote what energy it could to the culture of flowers. With the growth of education, with aesthetic culture and with the accumulations of money, which may be diverted from the necessaries of life to the luxuries, flower culture has become an important industry upon which millions of dollars are realized every year.

GRANVILLE LOWTHER

Roses for Central Washington

The following list of roses which do well in the Yakima Valley was compiled by Mr. Burton O. Lum, of North Yakima:*

Dark Red Roses—Etoil de France, H. T.; Louise Van Houtte, H. P.; Sultan of Zanzibar, H. P ; Prince Camile de Rohan, H. P.; Baron de Bonstetten, H. P.; Reine Marie Henriette, H. P.; Ulrich Brunner, H. P.; Gruss au Teplitz, H. T.; Princess de Sagen, H. T.; Avoca, H. T.; Jubilee, H. P.; Fischer Holmes, H. P.

Light Red Roses—Duke of Teck, H. P.; General Jacqueminot, H. P.; Richmond, H. T.; Papa Gontier, T.; Liberty, H. T.; Madame Battersea, H. T.; Captain Haywood, H. P.; Duke of Edinburgh, H. P.; Suzanne Marie de Rodocanachi, H. P. There are many other red roses that grow well in Yakima, but all of the above have been easily grown by the writer.

Pink Roses (including roses tinted with pink)—Antoine Rivoire, H. T.; Clara Watson, H. T.; Madame Carline Testout, H. T.; Magna Charta, H. P.; Paul Neyron, H. P.; Rosalind Orr, H. T.; Belle Siebrecht, H. T.; Madame Jules Grolez, T.; Prince de Bulgarie, H. T.; Maman Cochet, H. T.; Dean Hole, H. T.; Betty, H. T.; Duchess de Brabant, T.; Mrs. R. S. Sherman-Crawford, H. T.; Viscount Folkestone, T.; Anna de Diesbach, H. P.; Madame Gabriel Luizet, H. P.; Baron de Rothschild, H. P.; Jonkherr Mock, H. T.; La Tosca, H. T. These pink roses are especially adapted to Yakima.

Light Yellow Roses—Marie Van Houtte, T.; Amateur Teyssier, H. T.: Safrona, T.; F. Diegin, H. T.; Madame Pernet Ducher; Mlle. H. Cambier, T.; Chromatella, N.; Marechal Niel, N.; Sunset, T.

Dark Yellow Roses—Le Progres, H. T.; Harry Kirk, H. T.; Doctor Grill, T.; Madame Ravary, H. T.; Francisca Kruger, T.; Mrs. Aaron Ward, H. T.; Duchess of Wellington, H. T.; Madame Melanie Soupert, H. T.; Madame Hector Leuillot, H. T.; Melody, H. T.; Isabella Sprunt, T.; Sunburst, H. T.

The Hybrid Perpetuals, or H. P.'s, are quite hardy and hold their color better than the Hybrid Teas, or H. T.'s. The Teas must be protected in winter. All yellow roses do better in Yakima if they are in the shade part of the day.

White Roses—Frau Karl Druski, H. P.; Kaiserin, H. T.; Souv. Pres. Carnot, H. T.; Margaret Dickson, H. P.; White Maman Cochet, T.; Hon. Edith Gifford, T.; Ivory, H. T.

Neither the American Beauty, nor any of the La France roses, are included in these lists, as they do not grow well in Yakima. The buds blight with the exception of a few blooms in the late fall.

* Abbreviations H T, Hybrid Tea; H. P., Hybrid Perpetual, T. Tea; N, Noisette.

Flowers and Plants in the United States 1899 and 1909

	Acreage	Value
1899	9,307	$18,758,864
1909	18,248	34,872,329

The Cultivation and Uses of Annual Flowering Plants

Ageratum

"For strengthening the garden's color forces in blue, no annual is so good as the ageratum." Though ordinarily used in bedding and borders in contrast with such plants as geraniums, perillas, amaranthus, etc., the rose, white, and blue ageratums are exceedingly attractive when mingled with alyssum, candytuft, and similar plants. They grow well upon almost all soils and through a wide range of climate; for that reason many combinations with them are possible. The plants are neat, bushy, and erect, with a continual profuse clustering of pretty brushlike flowers throughout the season. The dwarf blue sorts make fine borders and are much used where contrasting color effects are desired. For early bloom the seed should be sown in cold frames or in boxes in the house early in the season—March—but for summer and fall bloom the seeds may be sown in well prepared beds in the open. Seeds sown in August will produce good plants for winter flowering.

ALTHAEA ROSEA. See *Hollyhock.*

Alyssum

For borders, edgings, baskets, pots, rockwork, and for cutting, a liberal use of this dainty little flower is recommended. For borders, the seed should be sown thickly so as to form masses. For winter bloom, sow late in August and thin the seedlings so as to stand about four inches apart, but for spring bloom or for borders the seeds should be sown in the open early in the spring, or even late in the preceding autumn in some localities. Where the plant will not endure the winter, however, early spring planting under cover, either in a cold frame or spent hotbed, or in boxes in a dwelling, is most to be relied upon. Alyssum can also be increased from cuttings made from strong new side shoots, as well as by division of the roots. By cutting back after the first flowers fade others will be produced. While white is the most common and popular color, there are yellow varieties of alyssum.

ANTIRRHINUM. See *Snapdragon.*

AQUILEGIA. See *Columbine.*

Aster

The aster is certainly one of the most satisfactory of the annual flowering plants. The great variety in its size, color, form, and season of blooming makes it a most satisfactory plant for supplying cut flowers. In fact, many of the improved sorts produce flowers equal in form and size to some of the better sorts of chrysanthemums. The range of color presented in this group is one of its chief merits. Strange as it may appear, the plant world is not very well supplied with blue flowers possessing characters which render them suited to domestic or commercial uses. In the aster, however, are found many shades of blue and purple and for this reason, if for no other, the aster should prove an attractive decorative plant. The habit of growth adapts the aster not only to close planting for cut bloom, but some forms are robust, tall-growing plants, well adapted for use in an herbaceous border where late bloom and careless effects are desired. The more compact-growing, large-flowered forms are most desirable for cut blooms, while the tall-growing, open types are most useful in wild gardens or for screens. The wild aster (*Aster novae angliae*) is one of the most beautiful and most satisfactory of this latter class. The vigor and ease of culture of the aster are factors which contribute to its popularity.

Plants from seed sown in the open ground in May bloom finely in September and October, when the flowers are seen at their best. For July and August bloom, seeds should be sown in March or April in a cold frame, spent hotbed, or in pots or boxes in a living room. Cover the seeds about half an inch deep with rich, light soil and when the plants have three or four leaves

transfer them to thumb pots or to other boxes, setting the plants about two inches apart each way. After all danger of frost is past transplant the plants so treated to their permanent home, where they should stand about 18 inches apart each way in well prepared beds. Fresh manure or manure used in too large quantities sometimes proves injurious to asters. Only thoroughly composted manure mixed with the soil is safe for these plants. Small quantities of air-slaked lime, or of fresh wood ashes, stirred into the surface of the aster beds prove beneficial to the plants. When given plenty of water and rich, fine soil asters can be grown into beautiful pot plants.

In some localities and during some seasons the aster is seriously attacked by the so-called black potato beetle or blister beetle (*Epicauta pennsylvanica*), an insect which feeds upon the partly developed buds, causing them to develop, if at all, into deformed, irregular blossoms. In such localities asters can be successfully grown under screens of mosquito netting or other thin cloth.

BACHELOR'S BUTTONS. See *Coreopsis*.

Balsam

Impatiens balsamina

A native of India, the garden balsam loves a hot sun, rich soil, and plenty of water. The young plants are quick, sure growers, and from seed sown in the open ground in May soon form handsome bushes thickly massed with large, rose-like flowers. Transplanting two or three times has a tendency to dwarf the plants into better shape and to make the flowers more double. Balsams are not often given room for perfect development; they will easily cover 12 to 18 inches of space each way. For the finest flowers choice seed is more than usually essential, for cultivation and selection have wrought wonders with this plant. The one objection to the balsam is its habit of producing its flowers, as it were, on the underside of the leaves, or inside the plant. While the individual flowers are beautiful, the obscure manner in which they are borne detracts considerably from the value of the plants. When used at the margin of groups or to crown a terrace they are shown at best advantage.

For early bloom the seeds should be sown about the middle of March in a gentle hotbed or in the dwelling house. As soon as the first true leaves have developed the young plants should be transplanted to thumb pots or to boxes where they will stand about two inches apart each way. An abundance of light and water is at all times necessary for success with these plants. Care should be exercised to prevent them from becoming drawn, as stocky, symmetrical plants produce the best flowers.

Calendula or Pot Marigold

The calendula or pot marigold is a hardy annual about a foot high. A moderately rich, light soil is most congenial to these plants, which should be placed about 8 or 10 inches apart, if planted in mass or in borders. The seed may be sown in the open ground quite early in spring, and the plants will be in bloom early in summer and continue to bloom until late in the autumn. The coloring of the flowers ranges through all shades of yellow from ivory to deep orange. The plants bloom freely and earlier than the marigold, and are useful in beds, borders, or backgrounds. The dried flowers are sometimes used for flavoring soups and stews. There are both single and double forms of the pot marigold. One of the most satisfactory methods of propagating this plant is from seeds sown about April 1 in the North in spent hotbeds or cold frames. After the middle of May, in localities north of Washington it will be safe to transfer the young plants to their permanent summer quarters.

California Poppy

Eschscholtzia

The eschscholtzia is the state flower of California, and an annual of striking character both as regards the form and color of its flowers, which are bright and rich in their tints of yellow and orange. The plants average about a foot in height, have attractive silvery foliage, and produce their large poppy-like flowers quite

lavishly from early spring until frost. They are most effective when grown in beds of considerable size, over which the seed may be thinly sown broadcast and lightly raked in. These sowings may be made early in spring, or late in autumn for earlier germination and bloom the next spring. The eschscholtzia is also very useful as a pot plant and for cut flowers.

Calliopsis, Coreopsis

Coreopsis is a genus of showy annual or perennial herbaceous plants, with graceful long-stemmed flowers well suited for bouquets. The hardy annuals of this genus are generally known by the name calliopsis. This is one of the garden's great forces in yellows, strengthened with rich maroons and browns. Seeds of the calliopsis for summer flowering in situations north of New York city should be sown in March in boxes in a living room or in a gentle heat in a greenhouse or hotbed. In localities south of New York the seeds may be sown in the open in May in good garden soil, with the hope of an abundance of flowers from August until frost. The plants should be thinned or transplanted to at least 10 inches apart each way. Their tall, slender habit makes neat staking and tying necessary. All are fine for cutting, especially *Coreopsis grandiflora* and *C. lanceolata.*

Campanula
Canterbury Bells, Bell Flower
Slipperwort

Campanula is a genus comprising both perennial, biennial, and annual flowering plants. These fine old plants are rich in color, profuse in bloom, and of easy culture. For outdoor effects, when planted in quantity, they are glorious, and finest full-blown specimens of such varieties as *calycanthema* or Canterbury bells can be transplanted to pots for house decoration by soaking the soil about them with water and lifting with a ball of earth. The seeds of the annuals should be sown in April or early in May. The seeds of biennials should be sown outdoors early in July, and the plants may be thinned or transplanted to temporary quarters as late as October.

The old practice of covering Canterbury bells with leaves through the winter is not satisfactory. Transplant them six or eight inches apart in a cold frame, where they will make large plants by spring and are as easily cared for as pansies. In the spring set them 18 to 20 inches apart in beds where they are to bloom. In June and July they flower most profusely, and are in fine form a long time. They also make beautiful pot plants for Easter. If sown early in good soil the hardy perennials will bloom early the next year. All varieties like a rich, sandy soil, with good drainage.

Candytuft
Iberis

The candytufts are among the best white flowers for edging beds, for planting in belts, beds, or massing, for rockeries, and for cutting. Several of the varieties are fragrant, and all are profuse bloomers The seeds should be sown outdoors in April where the plants are to bloom, and well thinned when they have grown about an inch high. Make a second planting a month later, and a third late in July for fall flowers. September sowings will give winter blooming plants. The soil for best results should be rich, and the plants given an abundance of water. They branch freely, and if some are removed the flowers will be larger.

Canterbury Bells. See *Campanula.*

Carnation. See *Pinks.*

Castor Bean
Ricinus

The castor oil plant, commonly spoken of as the castor bean, is especially valuable because it is one of the few annuals which can be used to produce a semi-tropical effect. Its rapid growth and large size make it valuable as the central object in groups where rich, luxuriant growth is required. The variety of color in the foliage of the different sorts of castor bean is of value in giving contrast, and when used in combination with cannas, caladiums, coleus, or scarlet sage most striking effects of contrast can be produced. As a background for lower growing plants

the castor bean has no equal among garden annuals. Only the annual climbing vines, when provided with suitable supports, equal it as a low screen. It can be used with good effect in groups, as masses along shrubbery borders, or as belts for covering and shutting out an undesirable view.

At the North, the castor bean is most satisfactory when started in March or early in April in a gentle heat. A hotbed, greenhouse, or living room can be made use of for the purpose. As soon as the first true leaves have formed, the young plants should be pricked out into small boxes or pots, where they should be kept growing slowly until all danger of frost has passed, when they may be transferred to the open. After transplanting the young plants, it is desirable that they have sufficient room to prevent them from growing too tall and consequently from losing their lower leaves.

If planted in the open ground at the same time garden beans are planted, the castor bean will make a growth of from four to six feet by the middle of August. This plant loves a rich soil, plenty of moisture, full sunlight, and great heat. The varieties range in height from 3 to 10 feet and have leaves of corresponding size.

CENTAUREA. See *Corn Flower*.

Chrysanthemums

The chrysanthemums, like the pinks, contain some of the most valuable of the commercial florists' products, both hardy perennial and annual flowering plants.

The large flowered types of chrysanthemums, which each autumn produce such gorgeous shows in the stores, florists' establishments, and conservatories, are not hardy, and since they are treated as greenhouse plants by the florists they are only mentioned in this list The class of hardy chrysanthemums, which should be more commonly seen in every flower garden, and which are known as pompons, are simply noted to give proper relation to the annual chrysanthemums which are the subject of this sketch.

These plants bloom most satisfactorily if the seeds are sown early in a hotbed or cold frame and the young plants transferred to the open as soon as the soil has become sufficiently warm to keep them growing without check. If started in a hotbed the young plants should stand 10 to 12 inches apart when set in their permanent locations. Somewhat less satisfactory results can be secured by sowing the seed about corn planting time in the open where the plants are to bloom. The seedlings should be thinned to stand at least eight inches apart. If the same care in regard to disbudding and pinching back is taken with the annual plants as with the large flowered perennials the work will be rewarded by greatly increased size of the flowers.

Clarkia

The clarkia is one of the prettiest hardy native annuals of the Inland Empire. It blooms freely, which characteristic, taken in connection with the variety and brightness of its flowers, makes a bed of them in full bloom an attractive sight. They are useful, too, for hanging baskets, for vases, as edging plants, for low massing, or for borders.

The seeds should be sown outdoors in early spring and the plants grown in partial shade. The clarkias thrive in a warm, light soil, and their period of bloom is midsummer and late autumn. The average height of the plant is 1½ feet.

Cobaea Scandens

Cobaea scandens is a rapid growing, climbing vine which is easily propagated from seed. The dark color and refined character of its foliage, together with its bell shaped flowers, render it a very satisfactory vine for covering broad areas. It is a less rampant grower than the moonflower, but furnishes quite as satisfactory a screen made up of much finer leaves. The flowers are not conspicuous, because of their modest colors and because they are hidden by the foliage. Their form, however, is pleasing and they are open during the day.

When the young seedlings have developed their first true leaves they should be transferred to three inch pots or to tomato cans and kept growing slowly until danger of frost is past. In the open,

a rich border should be provided, for as soon as hot weather comes on the plants grow very rapidly if ample food is at their command. A rabbit netting trellis or support is more satisfactory than cords or smooth wire for this plant, as it fastens itself chiefly by tendrils rather than by twining, as does the morning glory.

Cockscomb

Celosia cristа

The cockscomb are prized and planted as an odd and picturesque decorative feature of the garden. The dwarf varieties make novel and attractive borders; the tall ones form striking groups, and when interspersed with other lower growing plants in a border they produce a pleasing contrast. There are both red and yellow forms of the cockscomb, but the bright red and crimson varieties are most effective in gardens and also in winter bouquets, for which they are cut before fully ripe and dried in the house. The young plants can be grown from seeds sown in gentle heat in April and transplanted to the open ground the middle or last of May, or the seeds may be sown early in May in the open where the plants are to stand. Transplanting into rich soils about the time the combs begin to form makes the flower heads much larger. They are bright from midsummer until frost.

Columbine

Aquilegia

The columbine is a hardy perennial, with many horticultural varieties, and is a desirable border plant. Its habit of growth is to form large clumps. It blooms profusely early in the season and remains in bloom for a considerable period. It is quite hardy, and is useful for cutting. The peculiar pendant flowers are interesting in themselves because of their unusual form, and this feature, taken in connection with the graceful habit of the plant, gives each clump of columbine a striking and interesting appearance.

Sow the seed in the open ground in spring, preferably where the plants are to grow, and thin the young seedlings to about a foot apart. Seeds may also be sown in the autumn for flowering the following season. The plants thrive well under good garden culture, but such rare sorts as *Aquilegia coerulea* and *A. chrysantha* do best in partially shaded, well-drained nooks. Few hardy perennials are so easily grown from seed.

Coneflower

Rudbeckia

Many of the rudbeckias are hardy and perennial, but they may be treated as annuals. The flowers are quite showy and usually have yellow rays, though some are crimson and others more or less covered with brown toward the base. The rudbeckias are of very easy cultivation, thriving in almost any soil and climate. Most of them prefer a moist soil, but will thrive in the garden under ordinary cultivation. *Rudbeckia hirta*—the Blackeyed Susans, or "nigger-heads," as they are sometimes called—will thrive in the hottest and driest situations. *Rudbeckia triloba*, a biennial, perpetuates itself through self-sown plants. The *triloba* may be used quite effectively as a border to a large bed of delphiniums or as a screen, as it forms a dense bush between three and four feet high. The rudbeckias are propagated by means of seeds or cuttings, or by division. The Golden Glow, one of the most satisfactory plants of this group, is well adapted for planting in a shrubbery or herbaceous border. It grows to a height of from three to four feet, and may be used as a screen when lower growing plants are placed in the foreground.

COREOPSIS. See *Calliopsis*.

Corn Flower

Centaurea

Centaurea cyanus is also known as "blue bottle," "ragged sailor," "kaiser blumen," and sometimes as "bachelor's button." These bright flowered plants are of a hardy nature, requiring simple culture, yet they are among the most attractive and graceful of all the old fashioned flowers. When placed in water after cutting, the flowers increase in size. Seed of the annual sorts should be sown in the open in April or May and the young plants thinned to four to six inches apart. They thrive well on all

moderately rich garden soils. The perennials may be grown from seeds sown in gentle heat in March and planted out in May or June.

Cosmos

Cosmos is now one of the notable fall flowers. It is a strong, tall growing annual, yet its bright, bold flowers have a daintiness and airiness which is heightened in effect by the feathery green foliage. It is most effective when planted in broad masses or long background borders against evergreens or fences at some distance from the house and the garden walks. From seed started in the house in March or April the plants will have reached three or four feet in height by September. The bright colored, daisy-like flowers are borne in great profusion and come at a season when they are very acceptable. Because of the robust habit of the plant the young seedlings should be thinned to 18 inches apart when grown on moderately good soil. Sowing the seed late and in poor soil will dwarf the plants. In the latitude of Washington, D. C., the plants perpetuate themselves from self-sown seed. These volunteer plants can be taken advantage of for early bloom.

CYPRESS VINE. See *Ipomoea.*

DELPHINIUM. See *Larkspur.*

DIANTHUS. See *Pinks.*

DIGITALIS. See *Foxglove.*

ESCHSCHOLTZIA. See *California Poppy.*

Cypress Vine
Ipomoea quamoclit

The cypress vine is very distinct both in foliage and flower from the moonflower and the morning glories. The flowers are small, star shaped, and usually pink in color; they are feather-like both in form and delicacy. The leaflets being fine, the general appearance of the plant is light and airy. While the plant does not grow as robustly as those named above, it is well adapted for covering low screens and arbors. It grows readily from seed, which should be sown in a rich border rather thickly, about corn planting time, and the young plants thinned to stand four to six inches apart in the row.

Evening Primrose
Godetia

The evening primroses are choice, free-blooming annuals, with widely opened flowers of satiny texture, with delicate colors. They are suited for solid beds, border lines, for pots, and to grow in shrubbery borders in shaded places, where few other flowers will flourish. The seed should be sown in an open border or in a cold frame in spring. If the latter, the seedlings should be transplanted to stand about a foot apart in rather thin or sandy soil. These plants are also successfully treated as biennials by sowing the seed in July and transplanting the young plants to a cold frame, to be placed in the open the following May. The blooming season is from early spring until frost, and the average height of the plants is 1½ feet.

Forget-Me-Not
Myosotis

The dainty little flowers commonly known as forget-me-nots are hardy perennials that love cool, moist soils, and, like pansies, bloom most freely in fall and early spring. They make a satisfactory close border, the beauty of which is heightened by abundant bloom. The forget-me-not is also satisfactory as a winter-blooming plant for growing in cool rooms or cold frames. Another feature characteristic of this plant is that, after once having been introduced into a garden, it perpetuates itself from year to year by self-seeding like the poppy, portulaca, and several of the other desirable annuals. Sow the seeds in spring in a warm, sunny border. Most varieties bloom freely the first season and profusely the second year. The average height of the plant is six inches.

Four-o'Clock
Mirabilis jalapa

The mirabilis, sometimes called the "Marvel of Peru," is normally a perennial in its native region, the warmer parts of America, but under garden culture it gives satisfactory results when treated as an annual. The seed may be sown in the early spring under glass and the plants set out in May. The four-

o'clock is often used as a screen with good results. The colored part of the flower, which is white, various shades of red, and striped, is the calyx, drawn out in the semblance of a corolla and surrounded at the base by a leafy involucre. In some cases, as in *Mirabilis jalapa*, only one flower is borne on an involucre.

The plant is a quick growing, erect, bushy herb, attaining to a height of from two to three feet. Its blooming period is during the late summer and autumn. Because of its habit of opening its flowers only late in the afternoon and on cloudy days the popular name, four-o'clock, has been given. While this plant is a tender annual in the northern part of the United States, it frequently reproduces itself from self-sown seed, and even as far north as New York city it frequently manifests its perennial habit of developing tuberous roots sufficiently large to be lifted and stored like those of the canna.

Foxglove

Digitalis

The tall flower stems of the foxgloves are particularly attractive when seen growing among shrubbery or in bold masses along walks or drives. As a background for lower growing plants the foxgloves are also very useful and interesting. The spikes are frequently a foot or more in length and thickly strung with many showy, thimble-shaped flowers. Some of the new sorts rival gloxinias in shadings and markings.

Plants may be grown from seeds sown in the open in May and the seedlings transplanted where they are to grow in the open or, preferably, to a cold frame, where they make extra strong plants that will flower profusely the next season. They are most satisfactory when treated as biennials, sowing the seed every year in rich, deep soil and partial shade. The average height of the plants is from two to three feet. When the center spike begins to fade it should be cut out and the side shoots will, in consequence, grow more vigorously.

Gaillardia

In the gaillardias are found both annual and perennial plants offering a wide selection of varieties and a profusion of bloom over a long period. The blooming period begins early and continues late in autumn. They are well adapted to mixed borders and are very satisfactory as cut flowers. The stems are of good length, carry the flowers well, and keep fresh as cut flowers for a long time when placed in water.

The annual gaillardias are all propagated readily from seeds sown in the open, but earlier flowers will be secured by sowing seeds in a hotbed and transplanting the plants to the open as soon as killing frosts have passed. In either case the blooming plants should not stand closer than ten or twelve inches. They grow and bloom best when fully exposed to sun and air, and when planted on a fertile but light and well drained soil.

Godetia. See *Evening Primrose.*

Helianthus. See *Sunflower.*

Hollyhock

Althaea rosea

These too frequently neglected old-fashioned perennials are most pleasing and attractive when seen in groups or long rows against evergreen hedges or shrubbery as a background, and, in turn, form a very satisfactory background setting for plants of lower growth. The color variety in these plants is very great, ranging from pure white through almost every conceivable shade of yellow red, and rose to ashen-gray and almost black. Although hollyhocks are permanent and hardy, even during the first winter, it is advisable to make seed sowings every year, as the flowers on young, vigorous plants are much finer than those upon old ones. Seed sowings should be made in April or May, and not later than June, to flower the next year. In the final transplanting each seedling should be given a foot or more space each way to allow for full development. The average height of the hollyhock is four feet; many sorts, however, are much shorter, while an equal number are taller than the average above stated.

Ipomoea
Morning Glory, Moonflower and Cypress Vine

The plants included under the names morning glory, moonflower, and cypress vine, while all classed together botanically, are quite varied in form of flower and foliage. Their chief merit rests in the fact of their rapid growth and ability to cover large spaces in a short time. The shoots grow long and are well provided with foliage, two factors which adapt them well for temporary uses, such as covering structures and summerhouses, and for immediate effect upon new buildings. All three of the above named types grow readily from seed, the morning glory and cypress vine both giving good returns from seeds sown in rich borders about corn planting time. The moonflower can be propagated either from seeds sown in a hotbed about the first of March in the climate of Washington, or from cuttings carried over winter in a greenhouse. For best success with the Imperial Japanese morning glories and the moonflowers the seeds should be filed to make a slight aperture in the hard, horny covering, or they should be soaked for several hours in warm water. If these precautions are not observed a poor stand will usually be the result. Both these groups profit by being started in a hotbed or greenhouse in March or April, and are then transplanted to the open only after all danger of frost has passed.

Larkspur
Delphinium

Blue is a comparatively rare color among our cultivated plants, and for that reason the delphinium, which shows this color in great variety, is particularly valuable. The brilliant flower spikes can be seen from a distance and are strikingly effective in beds or masses, in borders, shrubberies, or in combinations with white lilies or other plants where a high contrast is desirable. The tall sorts should be planted among shrubbery or used as a background for other low growing plants whose bloom will produce a pleasing contrast with the larkspur. The dwarf types are better suited for bedding and for low borders. Improvements are continually being made in the size of the flowers, as well as in the length and fullness of the spikes. Some of the species flower both early and late, and the season for all can be prolonged by care in cutting away withered flower stems as fast as they appear. The delphinium is sometimes increased by division, but like most other plants they are more robust when grown from seed. This plant is easily propagated and adapts itself to many conditions, but in a soil deeply dug and well enriched with fine old manure their blooms are largest and best. For best results the plants must have ample room to grow; 1½ to 2 feet each way is not too much for the taller sorts.

Annual Varieties

These include the rocket and hyacinth-flowered larkspurs, so called from their long, narrow flower spikes. They bloom best in a rather cool, moist soil. The seed may be sown in the open border, either in spring or fall, preferably the latter, so that germination may take place very early in spring. As the seedlings grow, thin them to stand 6 to 18 inches apart, according to variety. The shades of color include light, dark, and azure blue, white, buff, rose, apple blossom, pink, brick red, red lilac, dark lilac, violet, and fawn. The varieties are seldom kept separate, as they are quite as pretty and convenient for cutting when sown in mixture. Some of these are really hardy biennials, but because they bloom the first season they are treated as hardy annuals.

Perennial Varieties

These are usually taller than the annuals, requiring more space between the plants. If sown in the autumn or very early in spring many will bloom the first season. The foliage is clean and attractive and the habit of growth strong, producing long flower spikes.

Lobelia

The Erinus varieties (lobelias) are charming little plants that bloom very quickly from the seed and continue gay with flowers all through the season. For

beds, edgings, baskets, and pots there is nothing prettier; their clear colors and generous bloom make them welcome anywhere.

The seeds may be sown outdoors in early spring where the plants are to grow. As the plants appear they should be thinned moderately, or transplanted several inches apart in rich, open soil. Liquid manure given while they are in bloom greatly improves the flowers. Many sorts are also good winter conservatory plants of trailing habit. The perennial or tall varieties are handsome, showy plants, found quite effective for backgrounds and grouping.

Marigold

Tagetes

There are two distinct types of garden marigolds, each with numerous horticultural varieties, derived from two distinct species.

The French marigold, which is the most compact and regular in growth, and consequently the most valuable as a bedding or a border plant, has been developed from *Tagetes patula*, while the African marigold, which is of a more spreading and open habit of growth and therefore less suited for bedding purposes, but well adapted for herbaceous or shrubbery borders, has been developed from *Tagetes erecta*. The common names of these plants give no clew to their nativity, both being tropical American plants, in spite of common names to the contrary.

The French marigolds are all useful bedding plants. The habit of growth is erect and compact, with good foliage. The flowers are well formed, bright in color, and occur from June until frost. While these plants can be grown and successfully brought into bloom from seeds sown in the open in April in the latitude of Washington, such plants do not give as early bloom or the profusion of bloom which will be borne by plants started in a house and shifted for a time into pots which confine the roots of the plant and check it, so that when set in the open the increased food supply has a tendency to induce the development of flowers rather than wood, a tendency which is maintained, much to the gratification of the gardener, throughout the season. When transferred to the open the plants should be set at least a foot apart each way. The same distance should also be given plants grown from seed sown in the open. There are both double and single forms of the French marigold. The named varieties are especially good, but very satisfactory results are obtained from mixed seeds.

The African marigolds frequently grow two or more feet in height, and for this reason are better suited for planting in mixed borders or along belts of trees and shrubs than in beds or masses in small areas. This is, however, the common marigold of the garden in America. The leaves and flowers are strong scented. The range of color in the flowers of this type of marigold is from sulphur yellow to orange, the darker shades being more commonly met with than the lighter ones.

Mignonette

Reseda

Every indoor or outdoor garden must have mignonette in plentiful supply. The seed can be sown at any time, and if successive plantings are made, its fragrant, modest colored flowers may be gathered outdoors until November. For early bloom in the open, sow seed in pots or boxes under glass in February or March and thin or pot off the seedlings, to make stocky plants for bedding out, as soon as severe frosts are past. To insure a succession of bloom throughout the season, sow a row or two at a time in the open about April 15 in the vicinity of New York, and earlier southward, repeating regularly at intervals of about three weeks till August. The July sowing will make good winter flowering plants. The average height of mignonette is one foot.

MOONFLOWER. See *Ipomoea*.

MORNING GLORY. See *Ipomoea*.

Morning Glory

The Imperial morning glory is the most varied and most beautiful of the group. One of its interesting features is the variety of its flowers and leaves. The

latter differ greatly. in shape, as well as in size; some are plain green, while others are oddly marbled and blotched with white or yellow. The colors and markings of the flowers vary from pure white to rose, crimson, and carmine through blues and purples of every shade to almost black. There are velvety single self-colors, a few doubles and semi-doubles, others with quilled or feathered petals, many fancifully bordered, blotched, striped, penciled, and marbled—hardly any two plants from a seed packet seeming alike. The vines are vigorous, growing rapidly to a height of 30 or 40 feet. In sowing or planting they should be allowed about twice as much space as the ordinary morning glory, and in the open should not be sown quite as early in the year.

Moonflower
Ipomoea bona-nox

The moonflowers are the most vigorous in growth of any subdivisions of the genus included in the above list. The leaves are large, frequently five or six inches across, and the large white flowers, which open soon after sundown, are frequently four to six inches across. These plants with good soil conditions and plenty of moisture will make a growth of from 40 to 50 feet during the season.

Nasturtiums

A wide range of colors has been developed in this favorite flower, the nasturtium, which for three or four months of the season makes a better display than almost any other plant. No other annual will produce such a profusion of flowers for so long a time with the same outlay of time and labor. The maximum of bloom is produced on thin soils, and the plant never flags through the hottest weather; in fact, too much rain or moisture greatly reduces the supply of flowers. In soils too rich the leaves predominate and the plants are apt to rot off in wet weather, especially if standing too close. The seeds should be planted an inch deep, and the seedlings thinned to 10 or 12 inches apart. The rows for bedding varieties should not be less than a foot apart, and for tall varieties four feet.

Dwarf or Tom Thumb Nasturtiums
Tropaeolum minus

These plants have a neat, compact habit of growth and attractive foliage, and are not infested by insects. Blossoms appear in two months from the date of seed sowing, and continue throughout the whole season. A bed of dwarf nasturtiums in full bloom is a sea of color. It is said that a good bed, 6 by 20 feet in size, will yield about 1,000 flowers per day. The average height of the dwarf variety is nine inches.

Tall or Climbing Nasturtiums
Tropaeolum majus

Besides their ordinary garden use for trailing over fences, trellises, stone walls, etc., the climbing nasturtiums can also be grown as pot plants for winter-flowering as screens, or as trailers for hanging baskets and vases. Sow plenty of seed in drills, and thin to six inches apart in the row. Like the dwarf forms, these plants bloom most quickly and profusely in poor soil. Their flowers are usually a little larger than those of the dwarf sorts. The average height of the plant is five feet.

Nemophila

The representatives of the genus Nemophila are dwarf, compact growing, hardy, annual herbs, which produce an abundance of showy bell-shaped flowers from early spring to late autumn, for which reason they are esteemed for borders and for bedding purposes. All the species may be propagated from seed. If the seeds are sown in the open about the middle of August and then transplanted in late autumn very early flowers may be obtained. For summer and late fall blooms the seed may be sown in the open in April and not transplanted. The nemophilas love a moist loam, with partial shade, and produce an abundance of showy flowers, which are very valuable for bedding and for cut flowers. The whole plant is more or less hairy.

Pansy

Viola tricolor

The pansy, sometimes called heart's-ease, is a favorite with almost everyone. It is a plant that demands more than ordinary attention, but none repays such attention more liberally. For very early outdoor bedding the seed is sown in the autumn—September—in a cold frame, or in rich, moist garden beds, from which the plants can be transferred to a cold frame, setting them two or three inches apart each way before severe winter weather begins. In spring three-fourths of them can be lifted out for bedding, and the rest left to bloom in the frame. For winter bloom in a frame, set the plants about twice as far apart, and thin out half of them in spring. Cover the blooming plants with sash, adding a covering of matting or straw in very cold weather. In mild weather remove the mats and lift the sashes to admit light and fresh air and to prevent the plants from becoming drawn. In outdoor beds raised a few inches above the ground, with a mulch of dry leaves and some brush to hold them in place, pansies will often winter nicely and bloom until midsummer, when a relay of young, vigorous plants should be ready to replace them.

Spring sowings should be made early, so as to secure good flowers during the early rains. Seed sown in a cool, moist place in June and July, and well tended, will give good flowering plants for fall. If they come into bloom in the heat of summer the flowers may be small at first, but as the weather becomes cooler they will increase in size and beauty. Through summer heat the flowers are finer in a somewhat shaded place, but in almost any situation good pansy seed will give fine flowers in spring and fall. Early fall sowings give the finest spring flowers.

Petunia

Because of the ease and facility with which all of the single-flowered varieties of the petunia can be grown from seed this plant commands attention as a worthy candidate for the summer flower garden. The young plants grow rapidly and come into bloom early, and in addition to this they furnish a continuous wealth of blossoms until destroyed by frost. The large-flowered strains are very beautiful and of great variety. While the single sorts are common and inexpensive, the double giant-flowered varieties are rendered expensive because they must be reproduced from seed which sets only after careful hand pollination of the flowers, which is in itself an expensive operation, or from cuttings, of which an individual plant can supply but a limited number.

For best results the seeds of all sorts should be sown in a gentle hotbed, cold frame, or in fine soil in a box placed in a sunny window in March or early in April for localities north of Washington, D. C. When the soil has warmed sufficiently and the danger of frost has passed, the seedling plants should be transplanted to a rich garden loam and placed about a foot apart each way. The seed of the double varieties is less vigorous than that of the single sorts and therefore requires more attention to prevent extremes of temperature and of moisture to insure good germination. If the seeds are sown in boxes in the living room, a pane of glass may with advantage be kept over the top to maintain a close atmosphere, and thus prevent the loss of moisture until the young plants are well out of the ground. In planting, the seeds should be scattered over the surface of the soil and brought in contact with it by firming. They should not, like most other seeds, be covered.

Petunias are attractive in beds and masses, serve well for broad borders or bands and thrive well in window boxes. They are not exacting as regards soil conditions, thriving well in almost any arable soil, and they endure drought well and bloom profusely.

Phlox

Phlox drummondii

The annual phlox, sometimes called flame flower, is particularly useful and attractive when sown in masses or ribbon beds of contrasting colors. Few annual plants are more easily grown from seed,

give a quicker return of bloom, or offer such a variety to choose from as do the phloxes. There are few desirable colors beyond their range, and if given good soil and plenty of water they furnish a supply of delicate flowers for cutting throughout the season. The phloxes are also useful as window garden plants, and may be used as an undergrowth for tall, bare-stemmed plants. The first sowing of seed should be made as soon as the frost is out of the ground in the spring; later ones in May, either where the plants are to bloom or in a seed bed, as the phlox transplants readily. In transplanting set the taller kinds about a foot apart; if planted too thickly they suffer from mildew. The removal of flowers and seed-pods makes the plants more bushy and compact and lengthens their blooming period. The average height of the plant is about a foot.

Pinks

Dianthus

The large and varied genus of Dianthus contains some of our most beautiful and most profitable flowers. The most of them are hardy perennials that bloom freely the first season, the plants remaining green all winter and blossoming the next year also if lightly protected by a mulch of straw, cut fodder, or leaves. Old plants flower the earliest, but as young ones give the largest, finest flowers, sowings are made every year. Seed can be sown under glass or in an open sheltered bed in March. The seedlings are easily transplanted and should stand 8 to 12 inches apart; dwarf ones, about six inches. If especially large brilliant flowers are desired, a bed of well mixed turfy loam, leaf mold, and well decayed manure should be prepared for them. Good drainage should be provided, as the plants are impatient of too much moisture and are more liable to winter-kill in moist than in well drained situations. In fact, the plant is hardy to severe cold, but succumbs when exposed to low temperatures in wet places.

The Carnation Pink

Dianthus caryophyllus

This plant, which is the forcing carnation of the American florist, can be grown from seeds sown early in the season in hotbeds, the young plants being given frequent shifts to pots of increased size as they grow until all danger of frost is past and the growing season is well on, when they may be transferred to the border where they are to bloom. If they are given a rich soil and an abundance of moisture, the bloom will more than repay the extra trouble taken. Seedling plants are more variable in character than plants propagated from cuttings, and for that reason are not well suited for commercial purposes.

On the continent of Europe this type of dianthus is more commonly used as a garden annual than in America. The form known as "Marguerite carnation," which has recently come into popular favor, is well adapted to cultivation as an annual. The majority of its flowers come double, and it has a pleasing habit of growth.

Poppy

Papaver

In the spring, even before the tulips are fairly gone, old gardens begin to be gay with poppies, which, in some one or other of their many forms, continue a procession of bright blooms until frost. No other plants possess so bold and brilliant a flower, coupled with the same grace of stem, airiness of poise and delicacy of tissue as the poppy. For beds and borders, with a background of green, there is nothing which will produce a more striking contrast. Some sorts are admirable for naturalizing in open wooded grounds; others, like the Shirley, are beautiful for cutting. A sandy loam suits poppies best, and as their strong tap roots are difficult to transplant it is well to sow seeds where the plants are to bloom. Seed sowings made in the autumn and at intervals in spring will provide a long succession of flowers. The seeds should be sown thinly and covered very lightly, as the seed is quite small. As soon as the young seedlings are well established thin the plants to stand about a foot apart. The plants which bloom most profusely are those grown from fall or early spring sowings while the earth is cool and moist.

Portulaca

This bright flowered, thick leaved annual (portulaca) is unrivaled for brilliancy among plants of low growth. It possesses the ability to flourish under extremely adverse conditions; even the hot sun and a light sandy soil, with sparse water supply, will not destroy it. It is satisfactory for beds, edgings, and rockwork, and for filling up irregular spaces or unexpected gaps in flower beds. As an undergrowth for taller plants it is also valuable. It flourishes, carpeting the ground with a mat of succulent foliage that in the forenoon is hidden by the gayest flowers The plant is particularly useful in the Northwest. The seed does not germinate until hot weather, and should be sown late. Beyond the sowing, this plant requires little care. The hardy character of the plant is shown by the fact that it can be transplanted while in full flower through the driest, hottest seasons. The average height of the portulaca is six inches.

At Washington and southward this plant will perpetuate itself by self-sown seeds. In some soils this is sufficient to cause the plant to assume a weedy character. It never becomes troublesome like its near relative, the weedy garden purslane, or "pusley" (*Portulaca obracea*)

Pot Marigold. See *Calendula.*

Ricinus. See *Castor Bean.*

Rudbeckia. See *Cone-Flower.*

Salvia. See *Scarlet Sage.*

Scarlet Sage
Salvia splendens

The scarlet sage is a standard bedding plant that keeps the garden bright with color until late in autumn. This plant lends itself to many uses; it makes a good pot plant, does well in window boxes, and is useful for cutting to give color. Its best use, however, is as a hedge or border plant where long broad bands of intense color are desirable.

In the climate of Washington, D. C., seeds should be sown in window boxes or frames in March or April and the plants set outdoors during the latter part of May, or the seed may be sown outdoors after the first of June if protected from heavy rains and strong winds. The plants grow and bloom profusely in any light, rich soil. Both the tender and hardy perennial sorts bloom the first year and all are treated as annuals.

Scotch Pink. See *Pinks.*

Snapdragon
Antirrhinum

The snapdragon is a valuable border plant. It flowers the first year from seed sown as an annual. The bright color and peculiar form of the flowers always attract attention. The newer sorts offer variety of colors and of markings. The spikes are useful for cutting and keep fresh a long time. From seed sown in the open ground in May plants will bloom in July and August. For early flowers the seed should be sown under glass in February or March and transplanted into beds of warm, dry soil moderately enriched. If protected by a cold frame or even a mulch of leaves, the plants will winter well and bloom early the following year. The snapdragon, like most perennials and biennials which bloom the first year, and of which a particular display is desired, should be treated like an annual and sown every year. The plant blooms freely and continually until frost, its average height being one and one-half feet.

Stocks
Matthiola

The group of plants known as stocks offers many desirable qualities. The plants are vigorous, have a good habit of growth, fragrant flowers in various colors, a long season of bloom, and are adapted to a wide range of cultural conditions. Stocks are suitable for bedding, edgings, pot culture, house or conservatory use, and for cutting. For bouquets and floral work the double white sorts are especially useful. To secure early flowers, seeds should be sown under glass in March or April, and the young seedlings transplanted when an inch high into other pots or boxes, or into the fine soil of a spent hotbed. Advantage should be taken of showery May weather to transfer the plants to garden beds or deep, rich soil, setting them about a foot apart each way. As with other plants, frequent trans-

plantings during the early stages of growth tend to give them a more dwarf and compact habit. For late flowers seed sowings may be made in the open ground in May. If plants that began to bloom late are carefully lifted and potted in the fall they will flower freely during the winter in a house or room that is tolerably cool and moist. The blossoms are very lasting. The average height of the stocks is from one to one and a half feet.

Sunflower
Helianthus

These tall growing, bright flowered annual plants have not received the attention they deserve. They have suffered the misfortune of having been cheapened by use as a burlesque. In reality, however, the tall growing, large flowered sorts, as well as the dwarf, many flowered varieties, are useful when skillfully employed in mixed plantations with other herbaceous annuals. The golden yellow disks are like sunbursts among the shrubbery. The tall habit of the plant and the dense foliage of some varieties suit them well for backgrounds and screens. Their long stems and extraordinary lasting qualities make them of value as cut flowers.

The seed should be planted in the open garden in spring, at about the same time that corn is planted, and the plants thinned to stand from two to four feet apart, according as the plant is dwarf or tall growing. There is wide variation in the height and habit of growth of the different varieties, which range from two to ten feet in height, with from one to many flowers.

Sweet Peas
Lathyrus odoratus

The sweet pea during the last decade has been greatly modified and improved by careful selection and cultivation, the flowers being larger and more varied in color and marking than formerly. The result is that the sweet pea has come to be one of the most popular annual flowering plants. It repays well the attention given it. The flowers are well suited for bouquets, and lend themselves well to table decoration. While the climbing habit of the plant is such as to prevent its use in groups and borders, its height is not sufficient to allow its use as a cover or screen for a lattice. The most satisfactory method of growing it is in long rows provided with rabbit netting wire, supported by strong anchor posts and intermediate stakes, to prevent the wire from sagging between its supports.

Sweet peas require a soil deeply tilled and well supplied with plant food. A satisfactory method is to open a trench about a foot wide and ten inches deep in rich garden loam, in the bottom of which about three inches of well rotted manure are placed, with two inches of fine top soil scattered immediately over it. Upon this bed sow the peas in double rows about eight inches apart, the seeds being placed from half an inch to an inch apart in the row. Cover the seed about three inches deep, and after the young plants appear and have attained sufficient height fill the trench completely.

As the sweet pea can hardly be placed in the soil too early in the spring, all general preparatory work should be done in the autumn, and the seeds sown as early in March as practicable. In sections with a winter temperature less severe than that of Washington the best results will undoubtedly be obtained from fall sowing.

SWEET WILLIAM. See *Pinks*.

Sweet William
Dianthus barbatus

The sweet william, which is to be found in every grandmother's garden, is one of the most satisfactory members of this group for annual planting. While seed can be sown in the open early in the season, about corn planting time, the best results in the way of early bloom come from plants produced from seeds sown in a hotbed not later than the 10th of March in the latitude of New York, the young plants being pricked out into flats or, preferably, into thumb pots, and later shifted to three inch pots before planting in the flowering border. The outside planting of hotbed grown plants should be delayed until the season has advanced sufficiently to prevent the plants suffering from a check by cold after being placed

in the open. The pot grown plants should be set at least ten inches apart and seedlings from seed sown in the open had best be thinned to stand at least eight inches apart.

The Scotch Pink, or Grass Pink

Dianthus plumarius

The Scotch pink is a hardy dianthus, which, when treated as an annual in like manner as the sweet william, gives very satisfactory results. The delicately fringed, variously colored, fragrant flowers give the plant an odd yet attractive appearance.

The flowers of all the plants of this group are most satisfactory for bouquets and table decoration because of the length of time they will keep in a fresh and attractive condition after being cut and placed in water.

Verbena

The verbena is a low growing annual, with a decumbent or creeping habit. The flowers are borne on terminal or lateral shoots, which lift themselves from five to seven inches off the ground, and when grown in mass the plants will form a mat which in full bloom will give the soil the appearance of having a carpet of flowers. Because of the ability of the plant to form a compact growth and produce a wealth of flowers over a long period, the verbena is frequently used as a bedding plant where carpet bedding effects are desired. The contrasting colors in the varieties which come true from seed allow of securing pleasing combinations of colors which are effective where low growing plants can be used. The length of stem and the texture of the flower are such that the verbena is of value for bouquets and table decorations. The verbena can be used with good effect in beds, borders, mounds, and in window boxes.

While the verbena grows readily from cuttings and from layers, seedling plants are more vigorous and as a rule produce better flowers. For the earliest bloom in the latitude of Washington, D. C., sow the seeds early in February in a moderately warm living room or greenhouse. For general outdoor planting the seeds may be sown about March 10, either in a living room, hotbed, or greenhouse. Soak the seed a few hours in tepid water and sow in seed boxes filled with light, rich soil; cover one-fourth of an inch deep, press down firmly, and water sparingly. When the seedlings are about an inch high transplant them into other boxes, placing the young plants two or three inches apart each way. If thumb pots are available use these in place of boxes. When planting out time arrives choose a bright, sunny situation. Make the soil rich and compact rather than light, but in all cases provide good drainage. Set the young plants 10 to 15 inches apart each way and give good cultivation until they cover the ground. With such treatment the verbena should give continuous bloom from early summer until killed by frost.

Zinnia (Youth-and-Old-Age)

The zinnia is easily grown from seed sown in the open ground. When sown in April the plants will bloom abundantly and continuously through the entire season. Of late, great improvements have been wrought both in the color and form of the flower. During the month of August zinnias are at their best. To secure large flowers and a profusion of bloom the plants must be given ample room for full development, as well as an abundant supply of food. Strong, rich soils suit the zinnia. If the seeds are sown in a dwelling house or in a hotbed in March and the young plants are pricked out once or twice before being placed in their permanent situations more satisfactory results will be secured than from outdoor sown seeds unless equal care in thinning or transplanting is given. The plants can be used for groups, beds, borders, garden lines, and summer hedges. Their average height is one and one-half feet.

L. C. Corbett,
Washington, D. C.

Planting Table—Flowers

Allow 10 days for every 100 miles north or south of New York. Indoor planting may apply to seeds started in the house, a hotbed or a cold frame, the last-named being available after the first of March in many sections. Weather may affect dates.

NAME	WHEN TO PLANT		DISTANCE APART (INCHES)	FLOWERING PERIODS	COLOR	COMMENT
	INDOORS	OUTDOORS				
Achillea		June-Oct.	12	July-Oct.	White	A perennial, two feet high.
Ageratum	March	May	6	June-Oct.	Blue, white	Annual, grown from seeds or cuttings.
Alyssum		May-June	4	June-Oct.	White	Excellent annual for borders.
Aquilegia		Sept.	8	June-Sept.	White, yellow, blue, pink	Hardy perennial. Blooms the second year.
Asters	April	May-June	9	July-Oct.	White, pink, yellow, red	Bedding annual. Use wood ashes.
Balsam		May	9	July-Sept.	Red, white, pink, yellow	Annual, to grow in clumps in the sun.
Calendula		May-June	6	June-Oct.	Yellow, orange	Easily grown annuals, that self-sow.
Calliopsis		May	6	July-Oct.	Yellow, brown	Annuals grow, but they like the sunny location.
Campanula		August	12	June-Aug.	Blue, pink, white	Perennial, blooming the second year.
Celosia	April	May	6	June-Oct.	White, red, pink, yellow	Annual
Candytuft		May 15-June 15	4	June-Oct.	Pink, white, red, purple	Annuals, for beds or borders
Centaurea		April	6	June-Oct.	Blue, white, pink	Annual, to grow in masses. Self-sown.
Chrysanthemum	April	May	6	July-Oct.	White, yellow, red	Annuals, for massing at a distance
Cobea	April		8	July-Oct.	Purple	Climbing vine. Plant seeds edgewise.
Cosmos	April	May	12	July-Sept.	White, red, pink	Tender annuals
Dahlia	April		36	Aug.-Oct.	White, yellow, pink, red	Late started plants give largest flowers.
Delphinium		June-Aug	12	July-Oct.	Blue, yellow, white	Tall perennials. Bloom the second year.
Dianthus	May	May	6	July-Oct.	White, red striped	Perennial, blooming the first year.
Digitalis		July-Aug.	9	July-Aug.	Pink, white, blue	Fine in hardy border. Bloom the second year.
Eschscholtzia		May	4	July-Aug.	Yellow, orange	Do not transplant. Foliage is pretty.
Gaillardia	April	May	6	July-Sept.	Yellow, red	Showy annual, for beds.
Gourds	April	May	4	Sept.-Oct.	Fruit-bearing	Excellent to hide unsightly objects.
Four O'Clocks	April	May	8	July-Sept.	White, pink	Annuals, for borders or beds.
Gypsophilia	April	May	10	July-Sept.	White	Fine to use for bouquets. Grow elegant.
Helianthus		May	12	July-Oct.	Yellow	Make a good screen. Try the new kinds.
Hollyhock		June	15	Aug.-Sept.	White, red, yellow, pink	Perennial. Spray with Bordeaux.
Kochia		April	12			
Larkspur	April	May	6	June-Sept.	Red, white, blue, pink	Grow in masses. Good for cutting.
Lobelia	April	May	4	June-Sept.	Blue, white	For low edgings.
Marigold	April	May	6	July-Oct.	Brown, red, yellow	Showy, easily grown annuals.
Mignonette	April	May	6	July-Oct.		Fragrant. Make successive sowings.
Myosotis	April	June	6	June-Aug.	Blue, pink, white	Perennial
Nasturtium	April	May	6	June-Oct.	Various colors	One of the best annuals.
Nicotiana	April	May	9	July-Oct.	White, pink	Annuals, opening toward evening.
Pansy	Aug.-May	April	4	April-Oct.	Many colors	Give a rich, cool, moist soil.
Petunia	Feb.-April	May	6	June-Oct.	Red, pink white	Tree-flowering annuals.
Phlox	April	May	8	July-Oct.	Red, white, yellow, pink	One of the best low annuals.
Poppy		April	4	June-Sept.	Red, white, pink, yellow	Do not transplant.
Portulaca		May, July	4	July-Oct.	Red, pink, yellow, white	For dry, sandy and sunny spots.
Pyrethrum		June	12	July-Aug.	Red, white, pink	Grow in masses. Good to cut.
Ricinus	April	May	36	No bloom	No flowers	Annuals, start in pots.
Salpiglossis	April	May	6	July-Oct.	White, brown, red	Good mid-summer annual and easy to grow.
Salvia	March	May	18	Aug.-Oct.	Scarlet	Give a green background and rich, sandy soil.
Scabiosa	April	May	9	July-Sept.	White, yellow, pink	Long-flowering annual.
Stocks	April	May	12	July-Oct.	Pink, white, scarlet, yellow	Good for beds and to cut.
Sweet Pea		April	3	July-Sept.	Many colors	Plant early in rich, moist soil, in the open.
Verbena	Feb.-April	May	6	June-Oct.	White, red, blue, pink.	Splendid annual for bedding in the sun.
Zinnia	April	May	6	June-Oct.	Red, yellow, white, pink	Good summer plant for beds.

DISEASES OF ORNAMENTAL PLANTS

Ornamental plants are for the most part subject to the same kinds of troubles as plants of the same species or family but which may have acquired more economic importance. Usually a reference to the list of diseases of kindred plants found in the main body of this work will give the reader the information needed for recognizing and controlling the diseases of ornamentals. A few of the more important ones are given in this section in alphabetical order with the exception of roses which may be found under *Rose* in the Floriculture section.

Anthracnose

Maples, oaks, lindens, sycamores and other trees are affected by some one of the anthracnoses. The leaves of young trees and shoots are affected. It may be controlled by the use of Bordeaux in the nursery and early in the season.

Reference

Duggar, Fungus Diseases of Plants.

Black Spot of Maple

Rhytsima acerinum (Pers) Fr.

This fungus occurs on maples, willows and other forest trees. It appears as an irregular black spot upon the leaf Not serious.

Carnation Bud Rot

Sporatrichum poae Pk.

A serious bud disease which has caused severe losses in greenhouses in several states. It causes a disfigurement of the flowers with eventual rotting of the entire flower in severe cases. Controlled by general sanitation and destruction of all diseased specimens by burning.

Reference

Duggar, Fungus Diseases of Plants.

Crown Gall

Bacterium tumefaciens

This disease is common to many species of plants. A full discussion will be found under *Apple Diseases*.

Decay or Brown Rot of Trees

Polyporus sulphureus (Bull.) Fr.

This fungus seems to be universal where trees are grown and attacks the elm, maple, oak, beech, birch, willow, poplar and many, if not most, other shade trees including the conifers.

When the fungus reaches the fruiting stage it appears as a bright, sulphur-yellow, sponge-like cluster, very striking in appearance. The spores find lodgment in wounds, broken limbs and knots and the growing fungus thus finds entrance to the heart wood, which decays and is eventually reduced to a brittle mass which may be readily ground to powder.

Control

The only practicable method of control is by painting wounds made by pruning or otherwise with some heavy antiseptic paint.

Reference

Duggar, Fungus Diseases of Plants.

Fusarium

A species of fusarium produces a wilt of China asters and a rosette of carnations. Sterilization of the soil seems the only remedy.

Reference

Duggar, Fungus Diseases of Plants.

Leaf Blotch

See black spot of maple, this section

Rhododendron Rust

Chrysomyxa rhododendri (Dec.) DeBary

This is the most common disease of rhododendron and occurs in practically all regions where the rhododendron is native and particularly where spruce and fir abound as the fir is also a host plant. No method of control has been worked out.

Powdery Mildew

See under *Apple, Pear, Peach Diseases*.

Root Rot

Several forms of root rot attack carnations, violets, asters, etc. The trouble is most likely to occur in alkaline soils or soils poorly drained. Care should be taken not to set out plants which are already affected and attention to drainage and manuring to correct alkaline conditions will be effective. These rots have a wide range of host plants. See under potato, lettuce, beans, etc., where it appears as a damping-off and rhizoctonia. See index.

Root Rot of Trees

Various forms of root rot attack shade as well as fruit and forest trees.

These will be found fully discussed under diseases of the various fruit trees. See index.

Soft Rot of Calla

Bacillus aroideae, Town

This organism has caused a serious soft rot of the calla which destroys the plants about the time of blossoming.

The disease occurs chiefly in the bulbs, flower stalks and petioles.

Controlled by selection of healthy bulbs and by changing beds every three or four years.

Reference

Duggar, Fungus Diseases of Plants.

White Rot

Polyporus squamosus (Huds) Fr.

This fungus fruits in a conspicuous bracket. It is found upon many species of forest and ornamental trees.

Prevent by painting all wounds to prevent entrance of spores.

INSECT PESTS OF ORNAMENTAL PLANTS

These plants are attacked by much the same list of pests as infest similar species amongst the economic plants. Reference to the various fruits and vegetables belonging to the same family will usually furnish the reader with the desired information as to the method of control in the case of a pest of a given plant.

Holly

Holly is sometimes troubled with scale insects of various species.

They may be controlled by the usual methods adopted for the fruits, which see.

Ivy or Oleander Scale

Aspidiotus hederae (Vall.)

General Appearance

Circular flat scale, one-sixteenth to one-eighth of an inch in diameter, the male scales being very much smaller. The color varies from light to dark gray. On lemons this species often appears quite red and is occasionally taken for red scale (*Chrysomphalus aurantii*), but the lack of the small, central dark exuviæ together with its smooth, flat surface makes it easily distinguishable from red scale and also from the greedy scale (*Aspidiotus camelliae*), which is decidedly pointed.

Life History

Same as the other species of this genus of which the San Jose scale is given as typical. This species is cosmopolitan and is everywhere throughout the state. It is a greenhouse pest and often causes alarm to citrus growers by appearing on the fruit, but we find it attacks only old "tree ripes." It is perhaps most serious in many of the olive orchards in the Sacramento valley, where it infests the fruits so as to make them unfit for pickling purposes.

Distribution

Throughout the entire country.

Food Plants

Ivy, oleander, holly, boxwood, orange and other citrus species, olive, plum, cherry, currant, maple, camellia, grass, clover, yucca, asparagus, fern, pepper tree.

Control

Same as for San Jose scale.

Natural Enemy

A small chalcid parasite works effectively upon this scale.

E. O. Essig

Privet

San Jose scale. Sometimes troubles hedges of this plant. See under *Apple Pests.*

Red Violet Louse

Rhopalosiphum violae Perg

General Appearance

All forms are dark red; the wings are noticeably clouded along the veins which easily distinguishes this species from all others infesting violets.

Life History

Viviparous females, winged and apterous, bring forth young continually throughout the early spring and summer months. Evidently the entire life cycle is passed upon the violet.

Food Plants

Cultivated violets.

Natural Enemies

This species is usually held in perfect control by internal parasites.

E O. Essig

Florida

Florida is mainly a peninsula 350 miles long by 60 to 100 miles wide. On the north there is an arm, reaching westward along the Gulf, more than 100 miles long and 50 wide, once known as West Florida. The extreme length of the state from north to south is 450 miles and it contains an area of 58,680 square miles, of which 4,440 is water. The surface is generally level, or slightly undulating; but in the northwest it is hilly, or at least broken and called hilly; yet none of the elevations rise more than 300 feet above the level of the sea.

For the main part the soil is formed of calcareous rocks, overlaid with sand, clay and drift. No state in the Union has so much coast line as Florida (1,150 miles) and none so many navigable rivers. Among the rivers navigable for steamers are the St. Mary, forming part of the boundary between Florida and Georgia, and navigable as far as the town of St. Mary's; and the St. Johns, which flows into the Atlantic near the northeast corner of the state. This river rises in the South, and with its tributaries and lagoons has more than 1,000 miles of navigable water. It flows through a series of lakes, lagoons and swamps, and for 150 miles above its mouth has a width of two miles. The Indian river is a narrow lagoon or sound about 100 miles long. The rivers rising in Alabama and flowing through Florida are the Perdido, Escambia and Choctawhatchie. Those rising in Georgia are the Appalachicola, Ocklockonee and Suwanee. Those flowing from Lake Okeechobee are Withlacoochee, Peace Creek, Caloosahatchiee. Rivers of the interior are Ocklawatha and Kissimmee.

The chief harbors of Florida on the Atlantic coast are St. Augustine, Fernando, Port Orange and Jacksonville, and on the Gulf coast Key West, Charlotte Harbor, Tampa, Cedar Keys, St. Marks, Appalachicola and Pensacola. Numerous lakes of pure water dot the state, the largest of which is Okeechobee, having an area of 500 square miles and discharging its waters by several outlets into the Everglades. The Everglades are swamps full of islands covered with vines and shrubbery, and in the rainy season mostly covered with water, forming an addition to the Lake Okeechobee. There are many small islands along the Gulf coast, and from the southern end of the peninsula, a chain of reefs and islands called quays or keys extend in a southwesterly direction for 200 miles. Many of the streams of Florida are subterranean, having been formed by the action of the water in wearing the limestone rock, which forms so large a part of the sub-stratum of Florida soils.

For agricultural purposes Florida may be divided into the Upland region, comprising the northern tier of counties; the Northern and Central Florida region, and the Treeless and Alluvial region, south of a line drawn from Charlotte Harbor to Cape Carnival. Again, the state is sometimes divided into sections designated by the natural productions or flora, as follows:

1. The oak, hickory and pine, upland region, comprising most of the northern tier of counties.
2. The long-leafed pine region, which lies chiefly in Northern and Central Florida, dividing it into rolling, flat and hummock lands.
3. The pitch pine, a treeless and alluvial region in the southern part of the state.

The hummock lands are small elevations or hillocks, rising above the surrounding swamps and generally covered with grass, shrubs or trees. Its surface soil is generally underlaid with clay and therefore the timber that grows upon it is adapted to the conditions described. All the fruit trees grown in Florida do well on the hummock lands, and it was formerly supposed they would not succeed on the sandy soils, but this has lately been proven a mistake, for by fertilizing from the marshes, or by the use of shells from the sea, or other methods, it has been proven that certain kinds of fruits, especially oranges, will reach a high state of perfection. There are many varieties of sandy soil, from the coarse sand containing 95 per cent of insoluble

matter to the hummock lands mixed with clay. These differences have been caused by the action of the winds and waves and have made a scientific study of the qualities of soil and their adaptability to certain forms of vegetable life necessary in order to reach a fair degree of success. However, by a study of adaptation of crops to conditions men are making large profits in fruits and vegetables grown for the early markets of the Atlantic coast cities.

The principal fruits grown are the citrous fruits such as oranges, lemons, limes. Other species of fruits are peaches, pears, plums, grapes, Japanese persimmon, or kaki, strawberries, pineapples, bananas, guavas, mangoes and cocoanuts.

Many kinds of vegetables are grown among which are beans, beets, cabbage, cauliflower, collards, egg plant, Irish potatoes, lettuce, watermelon, muskmelon, onion, okra, English peas, pepper, radish, squashes, rutabagas and sweet potato.

The marl or drained lands of the southeast coast raise mostly tomatoes, egg plant, peppers and okra.

Cocoanuts are grown mostly along the coast and in the southern part of the state.

Bananas are not largely cultivated for the markets but are grown mostly for home use.

Grapes grow rapidly owing to the long season for growth and the vines of the native varieties grow to be very large. The Scuppernong is the leading variety and produces immense quantities of fruit.

Pears are rather subject to blight. The most resistant varieties are the Kieffer, Le Conte and Smith.

Peaches grow in almost all sections, but seem to prefer the hummock or flat woods lands, if these lands are properly drained. The varieties of peaches recommended are the Alexander, Early Cream, Florida Crawford, General Lee, Imperial, Angel, Colon, Ferdinand, Honey, Peento, Waldo and Yum Yum.

GRANVILLE LOWTHER

Varieties of Fruits and Nuts for Central and South Florida Planting

The following list is recommended by Griffing Bros. of Florida.

CITRUS FRUITS—Budded on Sour Orange and Rough Lemon Roots.

ORANGES—Early Ripening, Boone's Early, Parson Brown, Centennial, Medium Early, Homasassa, Medium Sweet, Tangerine, Mid-Season, Mandarin, Pineapple, Ruby, St. Michael's Blood, Tangerine, Washington Navel, Late Orange, Jaffa, King, Tardiff, Valencia Late.

GRAPE FRUIT—Duncan, Florida Common, Marsh Seedless, Pernambuco, Triumph.

LEMONS AND LIMES — Kennedy, Villa Francha Lemons, Persian Seedless, Florida Key Limes.

KUMQUATS—Nagami (oblong), Marumi (round).

NUT TREES—

PECANS—Bradley, Columbia, Curtis, President, Randall, Schley, Stuart, Van Deman.

Japanese Walnuts, Japanese Chestnuts.

PEACHES—Angel, Bidwell's Early, Bidwell's Late, Florida Crawford, Florida Gem, Glen, Gibbon's October, Griffings No 4, Hall's Yellow, Honey, Howard, Jewell, Miami, Peento, Ceylon, Suber, Waldo.

PLUMS—Excelsior, Gonzales, Happiness, Kelsey, McCartney, Stumpe, Terrell.

FIGS—Brown Turkey, Brunswick, Celestial, Lemon.

JAPANESE PERSIMMONS—Hyakume, Okame, Triumph, Tana Nashi, Zengi.

PEARS—Cincincis, Keiffer, Magnolia, LeConte, Suwanee.

APPLES—Jenning's Florida.

MULBERRIES—Downing, Hicks, Merritt, Stubbs.

POMEGRANATE—Sweet, Purple Seeded.

GRAPES—(Bunch varieties) Agawam, Concord, Delaware, Elvera, Niagara.

GRAPES—(Muscadine varieties) James, Scuppernong, Thomas.

FROST AND PRECIPITATION FOR FLORIDA

Station	Frost				Precipitati'n
	Average Date of		Date of		
	First Killing in Autumn	Last in Spring	Earliest Killing in Autumn	Latest in Spring	Annual inches
De Funiac Springs	Nov. 21	Mar. 13	Oct. 27	Mar. 29	67.8
Pensacola	Dec. 5	Feb. 23	Nov. 12	Apr. 6	56.8
Talahassee	Dec. 8	Mar. 4	Nov. 4	Mar. 28	58.8
Jacksonville	Dec. 6	Feb. 19	Nov. 12	Apr. 6	53.4
Archer	Nov. 28	Mar. 9	Oct. 24	Apr. 16	54.9
Eustis	Dec. 28	Feb. 18	Nov. 28	Feb. 24	49.6
New Smyrna	Dec. 24	Feb. 17	Nov. 28	Mar. 18	51.1
Tampa	Jan. 9	Feb. 8	Nov. 28	Mar. 19	53.1
Bartow	Dec. 21	Feb. 16	Nov. 18	Mar. 17	54.5
Jupiter	Dec. 29	Feb. 14	Nov. 18	Apr. 7	58.7
Myers			Dec. 21	Feb. 14	55.1
Miami				Feb. 19	58.3
Key West					37.9

North Florida. For bloom period of Apples, see *Louisiana*.

Food

Time Required for Digesting

Food	How Cooked	H.M.
Apples, sour, hard	Raw	2:50
Apples, sweet, mellow	Raw	1:30
Bass, striped	Broiled	3:00
Beans, pod	Boiled	2:30
Beans and green corn	Boiled	3:45
Beef	Fried	4:00
Beefsteak	Broiled	3:00
Beef, fresh, lean, dry	Roasted	3:30
Beef, fresh, lean, rare	Roasted	3:00
Beets	Boiled	3:45
Bread, corn	Baked	3:15
Bread, wheat, fresh	Baked	1:30
Cabbage	Raw	2:30
Cabbage, with vinegar	Raw	2:00
Cabbage	Boiled	4:30
Carrot, orange	Boiled	3:13
Catfish	Fried	3:30
Cheese, old, strong	Raw	3:30
Chicken, full grown	Fricasseed	2:45
Codfish, cured dry	Boiled	2:00
Custard	Baked	2:45
Duck, tame	Roasted	4:00
Duck, wild	Roasted	4:30
Eggs, fresh	Raw	2:00
Eggs, fresh	Scrambled	1:30
Eggs, fresh	Roasted	2:15
Eggs, fresh	Soft boiled	3:00
Eggs, fresh	Hard boiled	3:30
Eggs, fresh	Fried	3:30
Fowls, domestic	Roasted	4:00
Hashed meat and vegetables	Warmed	2:30
Lamb, fresh	Broiled	2:30
Milk	Boiled	2:00
Milk	Raw	2:15
Mutton, fresh	Broiled	3:00
Oysters, fresh	Raw	2:55
Oysters, fresh	Roasted	3:15
Oysters, fresh	Stewed	3:30
Parsnips	Boiled	2:30
Pork, steak	Broiled	3:15
Pork, fat and lean	Roasted	5:15
Pork, recently salted	Stewed	3:00
Pork, recently salted	Fried	4:15
Potatoes, Irish	Baked	2:30
Potatoes, Irish	Boiled	3:30
Salmon, salted	Boiled	4:00
Sausages, fresh	Broiled	3:20
Soup, bean	Boiled	3:00
Soup, chicken	Boiled	3:00
Soup, mutton	Boiled	3:30
Soup, beef, vegetable	Boiled	4:00
Trout, salmon, fresh	Boiled	1:30
Turkey, domesticated	Roasted	2:30
Veal, fresh	Boiled	4:00
Veal, fresh	Fried	4:30

Forecasting Frost. See *Frost.*

Freight Rates of Movement in. See *Reduction of Waste in Marketing under Marketing.*

Frost

Frost is frozen dew; the moisture of the atmosphere crystallized by the cold. Young and tender plants are often injured by the frost, thereby causing much loss to the farmer and horticulturist. Inasmuch as the wealth of the world is mainly produced from the soil, all kinds of business and commerce are therefore affected by frost conditions and all classes, as well as the farmer and horticulturist, suffer loss. If, therefore, we could know the conditions and provide against them, it would greatly lessen the uncertainty of crops. With our present knowledge

this can be done in a measure, but there is much to be learned and much to be accomplished before we can be fully assured against losses caused by cold.

Frost occurs only during calm, cold nights when the mercury is as low as 32 degrees Fahrenheit. This statement makes it necessary to distinguish between a frost and a freeze. There can be no frost without freezing, but there can be a freezing temperature without frost provided there is little moisture in the air. Freezing occurs at that degree of temperature at which water will solidify; or at which ice will melt. Thus the freezing point and the melting point, or the point of fusion, are one. The freezing point of water is 32 degrees above zero; the freezing point of mercury is 39 degrees below zero; the freezing point of sulphuric ether 46 degrees below zero, and the freezing point of alcohol, 203 degrees below zero. The freezing point of water is the approximate danger point of vegetable life. We call the degrees of the thermometer below the freezing point, degrees of cold; the degrees above the freezing point, degrees of heat. When the atmosphere which comes in contact with the body of a plant or animal is colder than the body, it absorbs heat from the body and is called cold, because it is so in relation to the temperature of the body. All animals and plants have a certain power of maintaining the heat of the body in defiance of external cold. This power in animals is due to the process of combustion, in which carbon and hydrogen taken into the system as food, unite with oxygen. This is accomplished by means of breathing, which oxygenizes the blood. The normal heat of the blood of birds is 100 to 112, while in mammals it is 96 to 102. Thirty degrees below this normal temperature is almost sure death, because at this point circulation stops; while ten degrees above is almost equally dangerous, for then the system is consumed by heat. Plants, during the summer, store food; they breathe and manufacture heat out of food particles just as do animals, but not in the same degree nor in the same manner. Plant life resists cold by the radiation of heat. There is considerable difference in the rapidity with which the different varieties of plants give off heat. This can be illustrated by the differences of radiation in soil, rock and water. Animals know that during the cool nights of spring and autumn, after the earth has become cool, by huddling up against a large rock they can keep warm. It has held its heat longer than the soil.

Horticulturists know also that adjacent to large bodies of water the temperature is modified by the radiation of heat from the water after the soil has lost a much greater degree of heat. An illustration of this is seen in Western Michigan along the eastern shore of the lake, where a strip of territory about 15 miles wide and 150 to 200 miles long is protected against cold by the milder temperature of the lake during the cold season, and that region is a good fruit-growing section, whereas other portions of the state grow comparatively little fruit.

Danger Point

There is considerable difference in the power of plants to radiate heat, and in the rapidity of radiation, and these facts determine in a large measure their resisting power to a temperature greater than that of their bodies. It is very interesting and yet very difficult to determine with exactness the degree of resisting power belonging to any particular plant, for there are so many counter influences that modify any rules. The Missouri Agricultural Experiment Station has found that dormant peach buds can stand a temperature of eight or nine degrees below zero with no injury. When the buds are appreciably swollen, zero weather is the danger point; when the buds are showing pink, they can stand 15 degrees above zero; when the buds are almost open, 25 degrees is the danger point; when they are newly opened, about 26 degrees would be the point of danger; when the petals are beginning to fall, 28 degrees above zero is cold enough to cause uneasiness; when the petals are off, they can stand 30 degrees above zero; when the "shucks" (calyx tubes) are beginning to fall off, 32 degrees above zero is the danger point. This shows the different degrees of resist-

ing power of the same varieties of fruit during different degrees of development. The United States Department of Agriculture makes the statement that the danger point for apples when they are showing pink is 20 degrees above zero; in full bloom, 26 degrees above zero. Pears showing pink are in danger at 20 degrees above zero, in full bloom 27 degrees above; peaches showing pink, 23 degrees above and in full bloom, 28 degrees above. It will thus be observed that there is substantial agreement between the conclusions reached by the Missouri Agricultural Experiment Station and those of the United States Department of Agriculture, although these conclusions are differently expressed.

Mr. P. J. O'Gara states that in Southern Oregon the temperature at which the apricot is injured when in the bud is 28 degrees above zero, and 30 degrees when in blossom. Cherries are injured at 29 degrees, just before the blossoms open, and plums are injured at 30 degrees above zero when the flowers begin to show white.

It should be observed further that the latitude to which a tree is acclimated has much to do in determining the degree of cold it will stand without injury. Trees of the same varieties brought from Florida will not stand the cold of the Northern climate as well as those grown in the North, which have for several years, perhaps for generations, been used to the colder atmosphere. Furthermore, it makes a difference whether the cold comes suddenly or gradually. It is with plant life as with animal life, that the tendency of nature is to provide against injuries caused by sudden changes. Animals suffer more from cold if the change is sudden than if it is gradual. In the gradual changes there is a closing of the pores of the skin, a shrinking of the muscles and drawing upon the food substances for the manufacture of heat, a lighting of the fires of the system that protects in a degree not possible where the change is sudden. The same law prevails among plants, but not in the same degree. However, it is observable that following a very warm day, if it should turn suddenly cold, the fruit buds are much more subject to injury than if the same degree of temperature followed a cool day. In the winter of 1908 and 1909 in the Northwestern part of the United States, the temperature was lower during the months of January and February than for eighteen years before, and more damage was done to the tender varieties of fruit during that winter than had ever been known in the history of fruit growing in that region. We made in our own orchard and in the orchards of our neighbors the following observations:

First· Peach trees and the trees that belong to the prunus family, such as almonds and apricots, are among the tenderest trees and have less power to resist cold than apples, pears and other varieties. The almond will stand about 14 degrees below zero without killing; the peach will stand about 18 degrees. Among the varieties of peaches on our place the Early Crawfords were the tenderest, while the Elbertas, Carmens and Salways were comparatively hardy. A few feet of altitude when the mercury is down to the danger point may determine whether an orchard will be killed or not. For instance, in one orchard the trees were killed in a little depression or draw that ran through the place, but at a point twenty feet higher they were not killed. It was argued by some of the neighbors that this was due, in part, to the fact that this low portion of land was irrigated more and did not mature the wood as well, or that the wood was too sappy, and therefore more easily frozen. In making other observations I have concluded that there may be some force in this, and that if an orchard has been properly irrigated so that it has matured its wood normally, it is in better condition to stand the cold than where it is overirrigated, and therefore the wood sappy; or where it has lacked irrigation, and therefore the tree not sufficiently vitalized. Among the apples the cheaper varieties generally stood the freeze better than the higher grades. The exception to this rule was in the case of the Ben Davis, on which there was very little fruit the following year. It was shown

that the English walnut is tender, and the wood was badly injured by the freeze. Pear trees were comparatively hardy, about a medium between peaches and apples, or perhaps a little nearer approach to the apple. Plums were not hardy; there was a fair crop of prunes and but few apricots, as the wood was not hardy. Pears were heavily loaded with bloom and bore a good crop.

The effects of rain or extra humidity should be remembered when considering the resisting power of a tree or plant. It is the same as with animal life. If exposed to rain, the body radiates heat much more rapidly than if it is kept perfectly dry. As has already been remarked, plants do not respond so sensitively to these changes of temperature as do animals, but any person knows that he has less power to withstand the cold if his clothes are wet than if they are dry. It is so with plants. If a cold wave follows a shower of rain, plants are much more sensitive to the cold and in much more danger of being killed than if the atmosphere is dry. The degree of vitality, also, in a plant has much to do with determining its resisting power.

Conditions Which Affect the Frost Problem

There are three conditions that affect the frost problem. The first is elevation; the second is air drainage; the third is evaporation, usually from large bodies of water, which tend to modify the temperature.

In rough or hilly country there will be what is known as thermal belts, usually following the contour of the hills. Low or pockety lands will be relatively cold while higher situations above the level of the natural air outlets will be relatively warm and orchards situated on this higher land will not be so liable to suffer from frosts.

There are valleys that are often called lowlands through which the air currents sweep with force enough so that there is seldom frost to injure the vegetation. Reference has already been made to protection by lakes, bays, inlets or bodies of water that modify the temperature Even several miles inland this is often true. For instance, the prevailing winds from the Pacific ocean are generally from the west or northwest. These winds are obstructed by the Cascade mountain range so that the territory along the foothills on the east side of the mountain range is more or less protected from the winds, but there are mountain passes like the Cowlitz pass, for instance, through which these winds sweep with considerable force. The air currents coming through the Cowlitz pass and sweeping down the Naches valley, which is part of the drainage system of the Yakima and Columbia rivers, modifies the temperature in the Naches valley so that, while the valley itself is not at a higher elevation, only being about 1,100 to 1,500 feet above sea level, yet they are seldom injured by frosts, while the lands in the Ahtanum valley, only a few miles separated from the Naches and on substantially the same level, but sheltered from the winds of the coast by a higher elevation of the mountain, generally are not quite so well protected from frosts and ordinarily there will be a little more danger to fruit crops in the Ahtanum valley on a general elevation than in the Naches; but there have been notable exceptions. One of these exceptions was in April of 1911, when a cold current of air came down from the north and settled in the Naches valley, and did as much damage or perhaps more than in some of the other valleys on the same level. There are exceptions to the general rules growing out of the changes in the direction of the wind, but the fact still remains that wind currents have much to do in preventing the settling of frosts upon the earth's surface.

The question of how the higher altitude furnishes better protection from frost than the lower is one about which a great many persons inquire. We can perhaps better answer this by saying that we are living upon the bottom of an ocean of air very like the ocean of water in which living creatures breed and grow. This ocean of air is not less than fifty miles deep, and is perhaps much deeper than that. One law of this at-

mosphere is the same as the law of the sea, that is, that cold contracts it and increases its weight, while the heat expands it and lightens its weight, so that, because it is heavier the coldest air tends to settle into the lowest places on the uneven surface of the earth just as the coldest water tends to settle into the lowest places on the uneven bed of the ocean. This law may be demonstrated in the heating of our homes. Those whose homes are heated with hot water know that the pipes which carry the hot water from the furnace to the upper rooms are called the hot water pipes and that the hot water rises from the boiler in the furnace room to the upper rooms of the building, and that after the same water has been cooled by contact with the air of the upper rooms, it is carried back by return pipes into the furnace room to be reheated and rise again. Thus is kept up the general round of circulation during the winter. Another illustration is in the circulation of the air in our homes from hot air furnaces. The heated air rises from the furnace, pouring from the registers and driving the cold air of the rooms into the lower story where by means of cold air ducts it is carried into the furnace room either to be reheated or to be carried away from the house. Every traveler has noted how, after the sun has set and the air is cooling, the colder air tends to settle in the valleys, while the warmer air tends to rise to the higher altitudes; he knows that in ascending the hillsides he will sometimes feel very sensibly a change in temperature in a distance of a few feet. During the day, especially in the summer time, the temperature of the valleys is warmer than that of the higher levels, because the radiation and reflection are greater. This can be illustrated. If we stand beside a large building on a hot day and get the direct rays of the sun at the same time that we get the reflected rays from the building, we will find that it will be much warmer near the side of the building that reflects the sun's heat than it will some distance away from the building. During the day the south slope of a hillside receives the direct rays of the sun's heat, during the night these hills radiate that heat and send it into the atmosphere to warm the colder air coming down from the hills. An illustration of this heat radiation at night is seen in the heated stone buildings and pavements of a great city where long after midnight the walls and walks are hot, especially during the hottest weeks of summer. We have seen persons trying to sleep on the beaches or in the parks at night because the radiated heat from the buildings in which their rooms were located was unendurable. These facts, together with the uneven surface of the earth, cause a constant circulation of the atmosphere of our globe.

Why the Highest Mountains Are Covered With Snow

If heated air rises and cold air settles it is pertinent to ask why the highest mountains are covered with snow and why the air is colder as we ascend. There are two principal answers to this question.

The first is that or near the surface of the earth there are innumerable particles of dust and layers of clouds and vapor that act as a blanket or covering to hold the reflected and radiated heat from the earth's surface. It is the same principle as when we sleep in a cold room, the covering on the bed which keeps us warm does not warm the atmosphere of the room, but it holds the heat radiated from our bodies. So, if we rise above a certain altitude, we rise above that blanket of dense atmosphere which we call the earth's covering.

Another reason is that in the highest altitudes of the mountains there is less friction of air currents, less generation of heat through friction, and therefore after ascending above the vapor, dust and clouds into a rarer atmosphere it becomes colder. We say "we rise above the clouds," but we speak in comparative terms, because we have not, in ascending the highest mountains, gone beyond all clouds, but beyond the general altitude of clouds. An illustration of this is seen on the Pacific coast where the prevailing winds are from the west. These

winds carry the clouds against the mountain range and deposit a large amount of rainfall on the western slope. Comparatively a small amount of moisture is carried in currents high enough to cross the mountain range from the west to the east, for the average amount of rainfall on the west side is about forty inches per annum, while the average amount on the east side would be about ten inches per annum, or only one-fourth that of the west, but of the amount that is carried across the mountain range from west to east the highest peaks and the eastern slopes receive their share in the form of snow and ice, and the air is never warm enough at that altitude to melt it. When we say, therefore, that the higher altitudes are warmer, that is true up to a certain point; it is true in summer where there is much radiation of the sun's heat from the surface of the earth and after the sun has set and the cool air of the mountains is coming down the valleys; it is also true up to a certain altitude only, but beyond that the higher we ascend the cooler the atmosphere.

GRANVILLE LOWTHER

For additional information on orchard sites and soils, see *Selection of Site* under *Apple Orchard.*

FROST AND FROST FORECASTING IN THE NORTH PACIFIC STATES

* Protection against frost injury is by no means a new thing, although perusal of some recent writings and discussions would lead one to believe that it is. As a matter of fact, however, the protection of plants and fruits from frost injury dates back perhaps more than two thousand years. It is known that the Romans practiced heating and smudging as a protection against frost injury; this fact is vouched for by Pliny, who recommended the practice. Smudging was also recommended by Olivier de Serres, a French agriculturist, in the sixteenth century. He recommended the use of wet straw and half-rotten manures so as to produce a heavy smoke. In the latter part of the eighteenth century the practice of smudging was compulsory in parts of Germany, and failure to comply with certain set regulations resulted in prosecution before an officer of the law who imposed exemplary punishment. It is also recorded by Boussingault that the Indians of Peru practiced frost prevention, and that this was inherited from the pre-Spanish civilization. A reference to the literature which we have at hand shows some of the earlier work in frost prevention was by no means so crude as one would suppose. As a matter of fact, some of the modern practices are less scientific in their adaptations than the earliest attempts at frost prevention of which we have any record. During the eighties and early nineties the French vine growers did some remarkable work; and we find them even at that time using heavy oils as fuel, placing these oils in flat ironware dishes. There were also used many prepared fuels, which would render a very dense smoke. There had also been devised systems of automatic lighting which were more or less successful. These systems were operated by a mercuric column, not very much unlike some of our modern automatic alarm thermometers. Even at this time it was understood that there is a certain advantage in co-operation in frost prevention since the work done by one grower nearby aided in the protection of the crops of others. About the same time that the French vine growers were carrying on their work in frost prevention by certain heating and smudging devices, our California and Florida orange growers were experimenting. At this time some of the deciduous fruit growers of the Sacramento valley and elsewhere in California were also working along this line.

* Office of Pathologist, Medford, Ore Bulletin No 5

Mr. Edward A. Beals, of the U. S. Weather Bureau, located at Portland, Oregon, says with respect to the history of frost prevention in the Northwest:

* Very few growers in the Northwest a few years ago made any attempt to protect their orchards from frost, and those that did were not very successful,

* Weather Bureau Bulletin No. 41.

as their methods were crude, and where the necessity was greatest the orchards were badly located and the task was almost hopeless from the start. Frost warnings were issued by the Weather Bureau during that time, although very little attention was paid to them, as foreknowledge of frost is of practically no benefit to the horticulturist unless he is prepared to protect his crop from threatened injury.

In 1907 Mr. P. J. O'Gara, one of the scientific assistants in the Bureau of Plant Industry, was sent to the Rogue River valley to study the pear blight, which was making inroads among the pear and Spitzenburg apple trees in that section of the country. He quickly realized that the fruit growers were losing much more fruit by spring frosts than they were willing to acknowledge, and being familiar with orchard-heating methods in California, he soon induced a number of orchardists to adopt similar methods in the Rogue River valley. The plan was so successful the first year that it was tried the next on a fairly large scale and with even greater success. In the meanwhile a few orchardists in other important sections had taken up this work, and by the spring of 1910 the movement had obtained large proportions in four important fruit centers, viz.: Rogue River valley, Yakima valley, Lewiston orchard district, and the Boise orchard district.

ROGUE RIVER VALLEY

* When Frost May Be Expected and Where Frost Is Likely to Occur

The conditions obtaining in the Medford district are thus described by Mr. P. J. O'Gara:

In the spring it is found that during the day, that is between sunrise and sunset, the wind blows mostly from northerly quarters. These winds are not moisture laden as a rule, the relative humidity often being as low as twenty-five per cent at a temperature of seventy degrees Fahrenheit. During the night when frosts are likely to occur the winds die down altogether, or change to a southerly quarter. The winds from the south are very dry, and the relative humidity is often much lower during the period in which the winds come from the south. If the winds continue to blow from the northwest or westerly quarters, frosts rarely occur, because these winds tend to raise the dewpoint, or, in other words, bring in air with a larger percentage of water vapor present. While the water vapor content of the atmosphere is high, damaging frosts cannot occur. It is only when the dewpoint temperature approaches the freezing point or is below it that we may expect a serious freeze. As a rule it is only on the valley floor that serious injury may be caused by low temperatures during the blooming period or some time thereafter. Even on the valley floor where there may be some slight elevation no frosts occur, while serious injury may result only a few feet below. The hillsides surrounding the valley usually escape frosts altogether, and the average variation in temperature in favor of the lands lying above the valley floor is from five to six degrees; therefore, even though a heavy frost may occur on the valley floor, the temperature may not go to freezing on the uplands. During the past season some records were made by observing temperatures on and near the ground, as well as on the roof of the Garnett-Corey building, which is fifty feet above the street level. While temperatures ranged as low as twenty-three to twenty-five degrees on the ground and four feet above it, the temperature on the roof was from thirty-two to thirty-five degrees. There is at times, therefore, a difference of twelve degrees or more between the temperature on the ground and at a height of fifty feet above when taken on the valley floor. Under usual conditions we are quite safe in saying that there may be little danger to the crops on the higher lands surrounding the main floor of the valley.

The experience of the season of 1911 indicates that a heavy rain followed by a cold wave gives practically the same temperature on valley floor and hillsides, and also that under certain conditions

* Office of Pathologist, Bulletin No. 5.

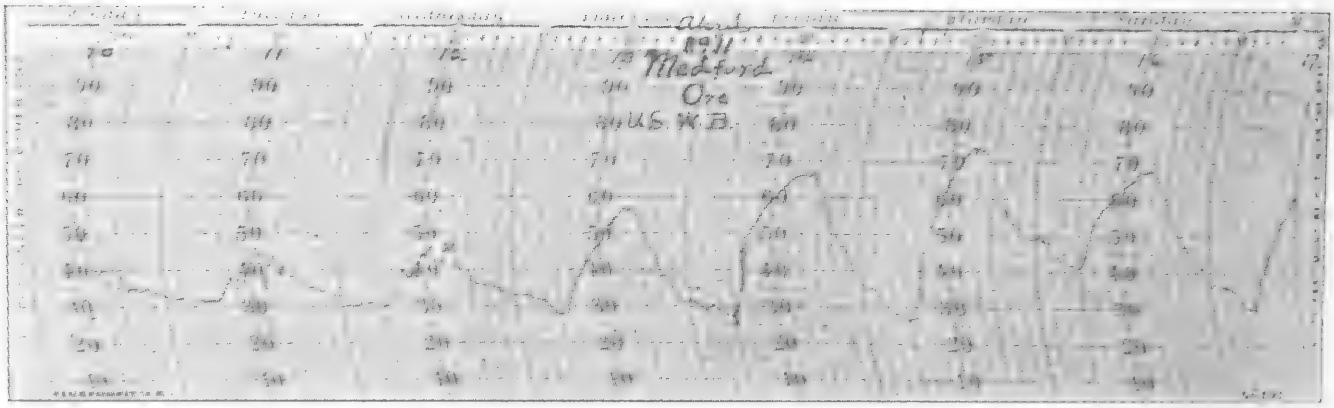


Fig. 1. Official Thermograph Record, United States Weather Bureau, Medford, Oregon. April 10 to 17 inclusive.
Note the short space of time during which low temperatures prevailed.

the injurious temperature may not continue for more than two hours and in some cases but a few minutes.

Frost Prevention

* High winds never occur during the time that the temperature may be below the freezing point. A slight breeze usually comes up from the south during the early morning. However, this breeze is never sufficient to more than waft the smudge through the orchards and does not interfere to any great extent in keeping up the temperature where fires are built. It will be seen that the conditions in the valley are ideal for the prevention of injury from freezing.

† The Rogue River valley is surrounded on all sides by mountains ranging from 4,000 to 5,000 feet above sea level, and with many peaks much higher. During periods of frost it is usually calm, and in the several years during which careful observations have been made the greatest movement of the air recorded during a spring frost has been from one to three miles per hour. Contrast this with the severe freezes which have occurred in other districts where wind velocities ranging from twenty to thirty-eight miles per hour were recorded when the thermometer stood at fifteen degrees or more below the freezing point. The fruit growers of the Rogue River valley little realize the wonderful climatic assets they are so fortunate to have. It can be truly stated that the only reason for losing a crop by frost is carelessness or neglect.

* Farmers' Bulletin No. 401.
† Office of Pathologist, Bulletin No. 5.

YAKIMA VALLEY

The conditions in the Yakima valley are described by Mr. T. R. Reed, special observer for that district.

The conditions favorable for frost in the Yakima valley include the usual conditions of high barometer following a spell of cloudy, cold weather in which the soil has lost its accumulated heat, clear sky and very light or no wind. It is considered by local observers that frost is most likely to follow a period of bad weather and the shift of wind from the south or southwest into the northwest or north. It is popularly supposed that danger of frost is small unless the veering to northerly quarters has been preceded by quite a marked period of southerly wind. This of course may be a popular way of indicating the necessary intensity and duration of the cyclonic low* occupying the Northwest; but it is worthy of note that judging from observations this season, dangerous frost is not likely except following protracted cloudy and cold weather, and that all the really serious frosts of the season have followed days on which the maximum temperature has been under 65 degrees and the current temperature under 60 degrees at the time of the afternoon observations.

High barometer alone, while causing frost in other localities in the state, has repeatedly failed to bring freezing temperatures to this valley, attributable partly, perhaps, to active air movement often occurring in connection with anticyclonic weather. A freeze may occur

* Note—An area of low pressure at the northwest of a given point would be accompanied by southwest or south winds.

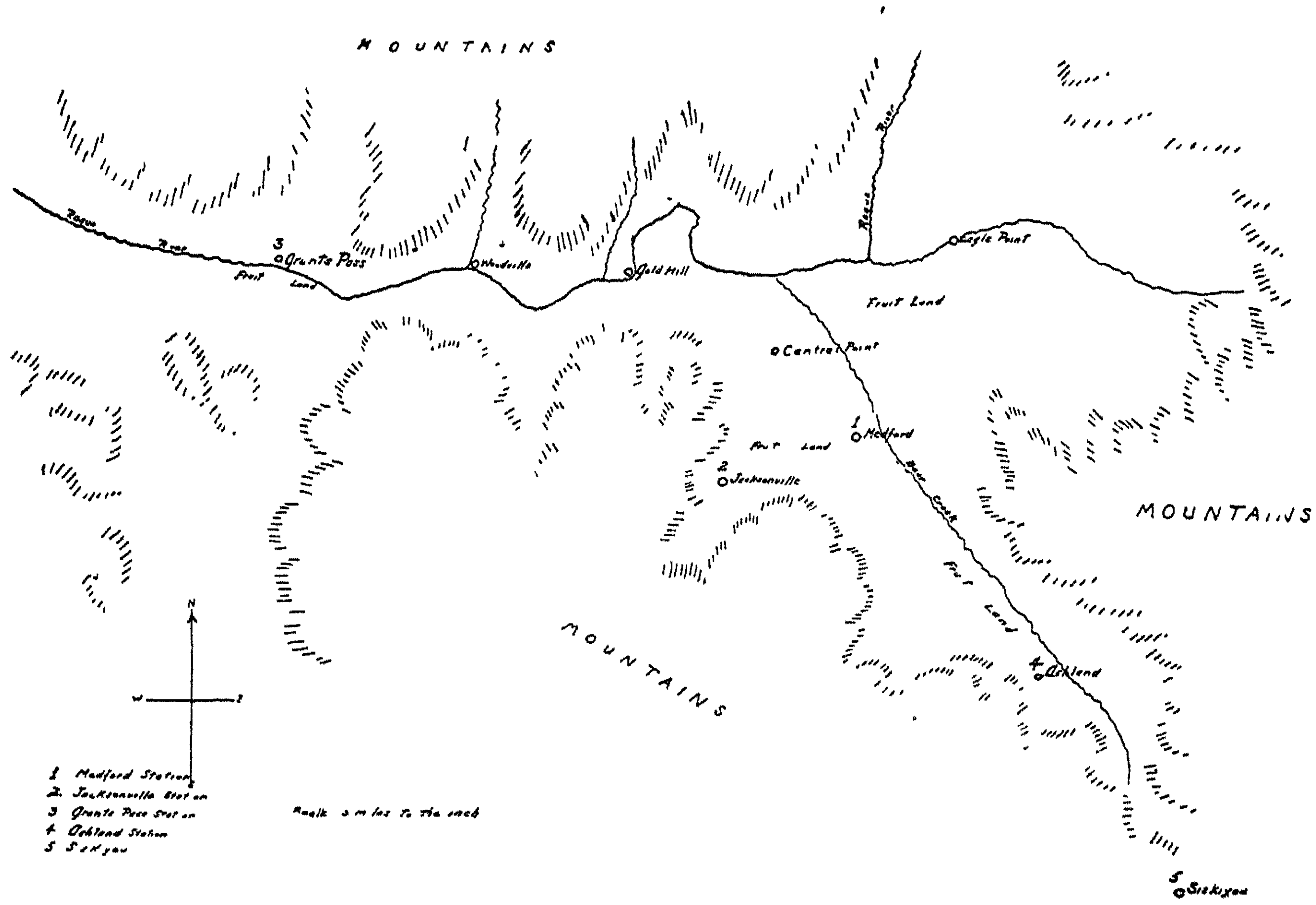


Fig. 2. Rogue River Valley Fruit District.

—*After Reed.*

here when the Northwest is occupied by low pressure; in fact, when a rain forecast would seem more legitimate than a frost warning, as on the night of the 6th of April; but this is an uncommon condition. Under such conditions the barometer may show no fluctuation worth speaking of, the surface currents may be from the south, in fact nothing to warrant a frost warning being issued except the fact of a clearing sky and a sharp fall in temperature.

The forecaster has then to determine whether the wind is to remain light and the sky clear, and this is an extremely precarious undertaking. Perhaps the daily rise in the barometer occurring at the time his decision is being made adds to the difficulty; and he must be able to distinguish to a certain extent between the periodic and the unperiodic movement, for it is the latter upon which he depends in a large measure to foretell the condition of the sky. Under such conditions, and unless the forecaster is sure of his position, it is wiser to place on their guard those who wish to protect their orchards, for the growers would rather be warned a few times unnecessarily than to have freezing temperatures descend on their orchards without forewarning.

The freeze occurring on the morning of April 6, 1911, when the temperature at North Yakima dropped to 25 degrees, could scarcely be foreseen, either from the weather map or from local observations, but it is a type of local freeze which should be studied and for which the local observer should be constantly on guard.

The ensuing freezes, which occurred with unusual frequency and severity for this section, were more easily foreseen. Between the inclusive dates of April 5 and 15 nine heavy frosts were recorded in North Yakima, and during the first half of the month there were more than this number in the neighborhood of Moxee and on the low ground below Union Gap. Seven times the minimum temperature dropped to 28 degrees or lower at the North Yakima station. The severest freeze of the entire period occurred on the morning of the 13th of April. The North Yakima station registered 24 degrees; in Moxee 16 degrees was reached, and the temperature in the lower valley ranged from 17 degrees at Sunnyside to 28 degrees at Parker Heights.

On the two mornings following what was very nearly a repetition of the phenomenal temperatures of the 13th was experienced. It was undoubtedly a strenuous period for the fruit men and one which is not likely to be repeated for many years. It showed the necessity of using an ample number of smudge pots and also the value of orchard firing on a large scale, showing the greater ease of heating a large district than a small one, or one in which heating is practiced only in a sporadic way.

North Yakima men were unsuccessful in maintaining safe temperatures, partly because they used too few pots—generally about 40 to 50 to the acre—and partly because each heated orchard was surrounded by unheated ones, and the wind, which was a feature of several frosty nights, effected a dispersion of heat and smoke. When practically all the orchardists fire, windy conditions can much better be coped with. On the morning of the 11th in particular orchardists reported that whereas under ordinary circumstances they could raise the temperature six degrees to seven degrees with 55 pots to the acre, on this morning it could only be raised three degrees. On the south slope of Nob Hill the smoke blew rapidly away, scarcely reaching the lower branches of the trees.

It was on this night (10th-11th) that the severest freeze occurred in the Nob Hill and Fruitvale districts, which are generally least affected by frost, the former being considered immune. The thermometer in the Weather Bureau shelter in North Yakima registered 29 degrees, and in Moxee 28 degrees; 31 degrees was reported from Parker, 28 degrees from Zillah, and 33 degrees from Sunnyside. That conditions as usually experienced suffered a complete reversal will be seen when it is stated that the temperature

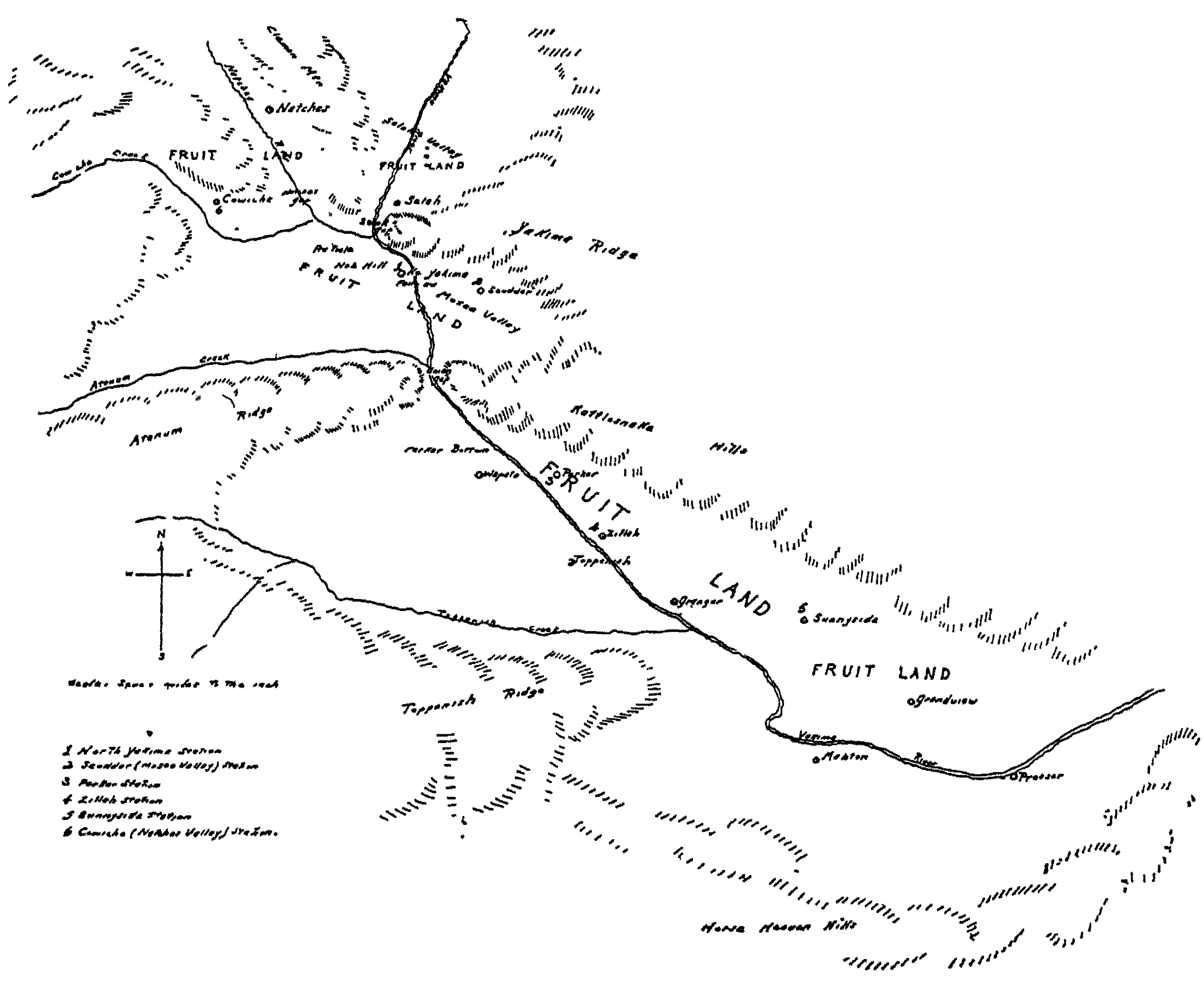


Fig. 3. Yakima Valley Fruit District.

—*After Reed.*

on Nob Hill and Fruitvale varied between 20 degrees and 23 degrees.* The reports from these districts showed much uniformity and many readings were made from reliable instruments. Moxee varied only a degree from North Yakima, and Sunnyside, which more often corresponds with Moxee, was even warmer. An interesting problem is here presented and its solution may disclose some interesting facts. The following is suggested by observations this spring:

A study of a topographic map of the region should be made in order to appreciate the situation. The Yakima valley is inclosed on all sides by mountain ranges varying from 2,500 to 3,000 feet in height and higher in the Cascades to the west. Access is had to the valley by two gaps on the north and one on the south. Nocturnal air drainage will always be from north to south under normal conditions, following the slope of the land, and observations show this actually to be the case. Fruitvale and the northern slope of Nob Hill are the first to benefit by the northwest breeze from the Naches canyon, as they lie directly in its course and in close proximity to the Nachez gap, from which it issues. There may be a similar breeze from Selah gap, a little to the eastward, but observations do not cover this point, nor are there any extensive orchards in line with Selah gap to benefit by such a breeze if there were one.

The Naches valley above Naches gap forms a natural reservoir for the air drainage from a vast mountainous area, and it is natural to conclude that when the convergent air is expelled into the Yakima valley below through the outlet formed by Naches gap a mixing of the air and possibly an adiabatic warming ensues, which would account for the comparatively higher temperatures encountered in the region lying directly in its path, as at Fruitvale, and the comparatively lower temperatures in the Fairview and Moxee districts, which lie several miles southeast of Fruitvale.

The Weather Bureau station is located in the city of North Yakima, and, therefore, between the two districts under discussion, Fruitvale being northwest of the city and Fairview and Moxee southeast. The thermometer at this station strikes a pretty fair mean, for while Fairview is often two degrees and Moxee five degrees to eight degrees colder than the North Yakima station, Fruitvale is usually a few degrees warmer. As the breeze from Selah gap spreads out and flows across the valley it loses its force, its temperature is lowered by radiation, and with further southeastward movement its character is changed from a protective wind to a more or less destructive one.

On the morning of the 11th, when the conditions in these districts reversed, a freezing wind was blowing from the south and southwest, having blown from this quarter throughout the night. There was no counter breeze from Naches gap, and the minimum temperature reported from the Naches valley above, a district from which comparatively high temperatures are usually looked for, was 22 degrees. Thus it appears that strong connection exists between a reversal of the customary wind direction and a reversal of temperature conditions in the several localities under discussion.

Boise

Edward L. Wells

(See diagram C)

The Boise valley is well suited to the growing of such fruits as apples, pears, prunes, sour cherries, and common berries. Some fruit has been grown in the valley for many years, but it is only within the last few years that scientific fruit growing on a commercial scale has become an important industry.

While the entire region is more or less subject to spring frosts these frosts are rarely sufficiently severe to cause widespread damage. For this reason, prior to

* This statement was based on temperatures as recorded at Scudder's station, located at the mouth of the Moxee valley. Had we more stations in the valley southeast of Scudder's I believe they would show that minimum temperatures do not vary a great deal from those recorded at Bender's station in North Yakima The district at the junction of the Moxee and Yakima valleys, represented by the Scudder station, is probably the coldest in the region above Union gap, due to the air drainage from not only the Selah and Naches valleys, but also from the Upper Moxee.

1909, comparatively little attention was given to measures to protect fruit from frost injury. The spring of 1909 was one noted for a succession of damaging frosts, resulting in almost a complete failure in many orchards. This failure turned the attention of the growers toward protective measures, and some of the more progressive of them provided themselves with oil pots and oil for use in 1910. The spring of 1910 was much more favorable for fruit than that of 1909, so much so that there was a good yield of fruit in most of the unprotected orchards, as well as in those that were protected. This being true, there was little increase in 1911 over the area heated in 1910; the entire area in the upper part of the valley adjacent to Boise probably not exceeding 1,000 acres. Like that of 1910, the spring of 1911 was not a good one to demonstrate the efficiency of protective measures, for while some very low temperatures were experienced, these low temperatures occurred when the buds were least susceptible to injury, and little damage occurred that could be directly traced to frosts.

It is probable that orchard heating will not become common in this valley as it is in the Grand valley in Colorado and in the Rogue River region in Oregon, until another season like that of 1909 is experienced, when the practical value of heating can be demonstrated.

The topography of this region is peculiar and gives rise to some weather conditions that make frost forecasting a difficult matter. The Boise river, in its upper reaches, flows through a rugged mountainous region. About six miles southeast of Boise it emerges from a deep box canyon, the mouth of which marks the head of what is known as the Boise valley, which extends thence northwestward with increasing width toward the Snake river. Northeast of Boise are the Boise mountains, reaching in 12 miles an elevation of 7,500 feet, or 4,800 feet above the city. Toward the southwest the ground rises in a series of widening benches. Through this bench land, where most of the large orchards are located, run several water courses, rather unimportant naturally, but forming a means for air and water drainage, and apparently playing an important

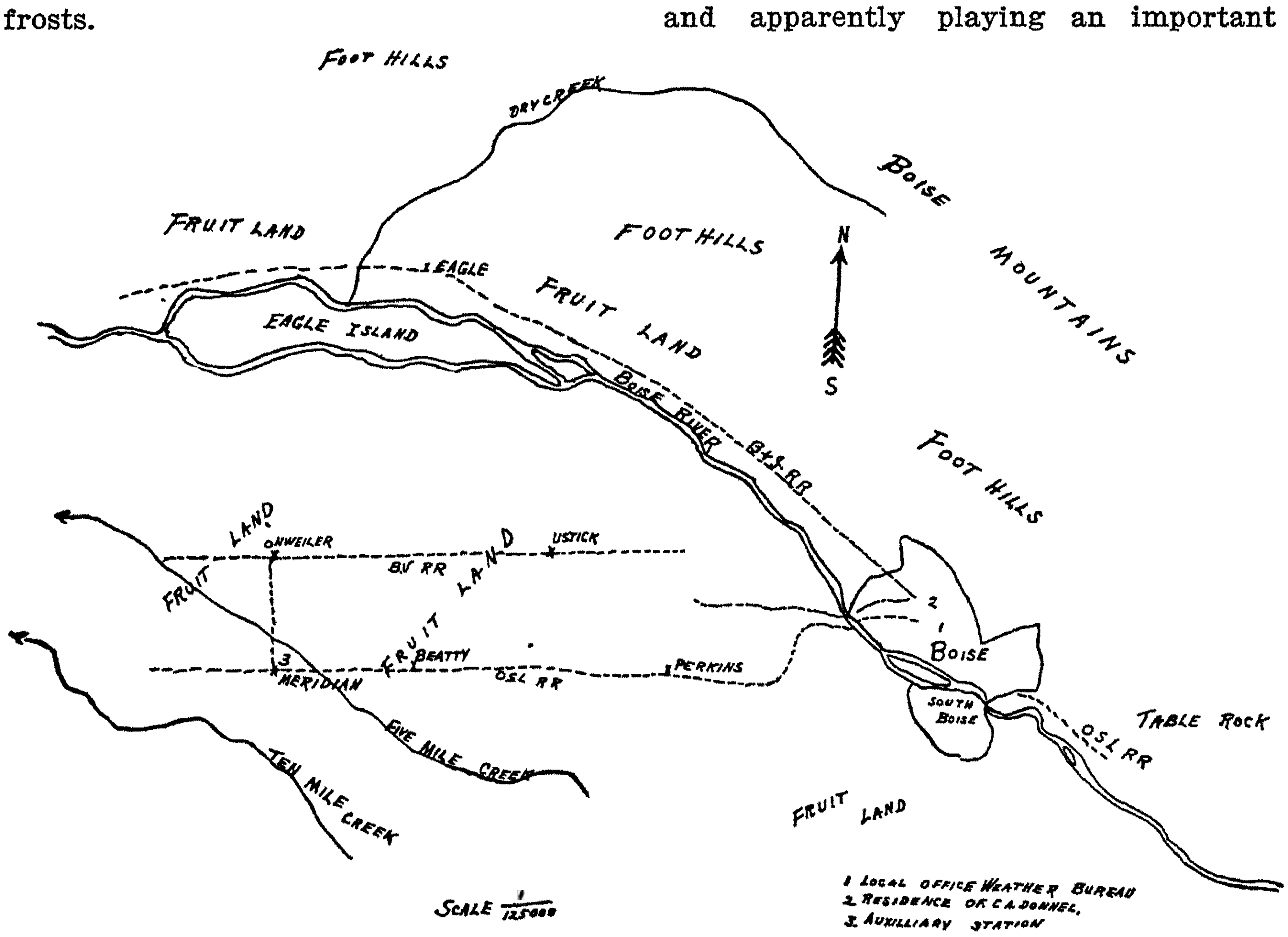


Fig. 4. Boise Valley Fruit District

—*After Reed.*

part in determining local temperatures on frosty nights. The entire region may be classed as arid, having approximately 13 inches of precipitation annually at Boise, and somewhat less at points away from the mountains. Water for irrigation is supplied by the Boise river.

In fair weather there is quite a noticeable mountain and valley breeze blowing down the valley, or from the southeast from early morning to about 10 a. m. and up the valley or from the northwest in the afternoon. Frosts occur ordinarily upon the approach of a strong high-pressure area from the northwest. The outflow from this high, combined with the ascending currents already mentioned, makes a strong northwesterly wind in the afternoon, which has come to be considered as the surest indication of frost. At night, in addition to the ordinary nocturnal lessening of the wind velocity, the descending current opposes the outflow from the high, causing a stagnation of the air highly favorable for the occurrence of low temperatures near the ground. At such times there is a noticeable tendency for the colder air to settle into the shallow depressions along the water courses already mentioned. When conditions for rapid radiation are particularly favorable no two thermometers in the valley will indicate the same temperature. At other times the distribution of temperature is fairly uniform. Whenever there is any considerable amount of wind at night frost does not occur.

Sometimes when the crest of the high reaches or passes this region before morning an easterly wind will spring up. A brisk easterly wind, coming as it does off the mountain range, partakes of the nature of a chinook. Usually the effect of these chinooks is hardly noticeable except over Boise and the belt of land lying between the foothills and the river. Sometimes, however, the effect becomes noticeable on the bench lands, and on rare instances the chinook has been known to pass over the city and materially affect the temperature on the bench.

Lewiston-Clarkston District

For the purpose of a study of the temperature conditions at different points in the valley a temperature station was established in a favorable location in the Clarkston (Wash.) section, one and a half miles southwest of the Weather Bureau station.

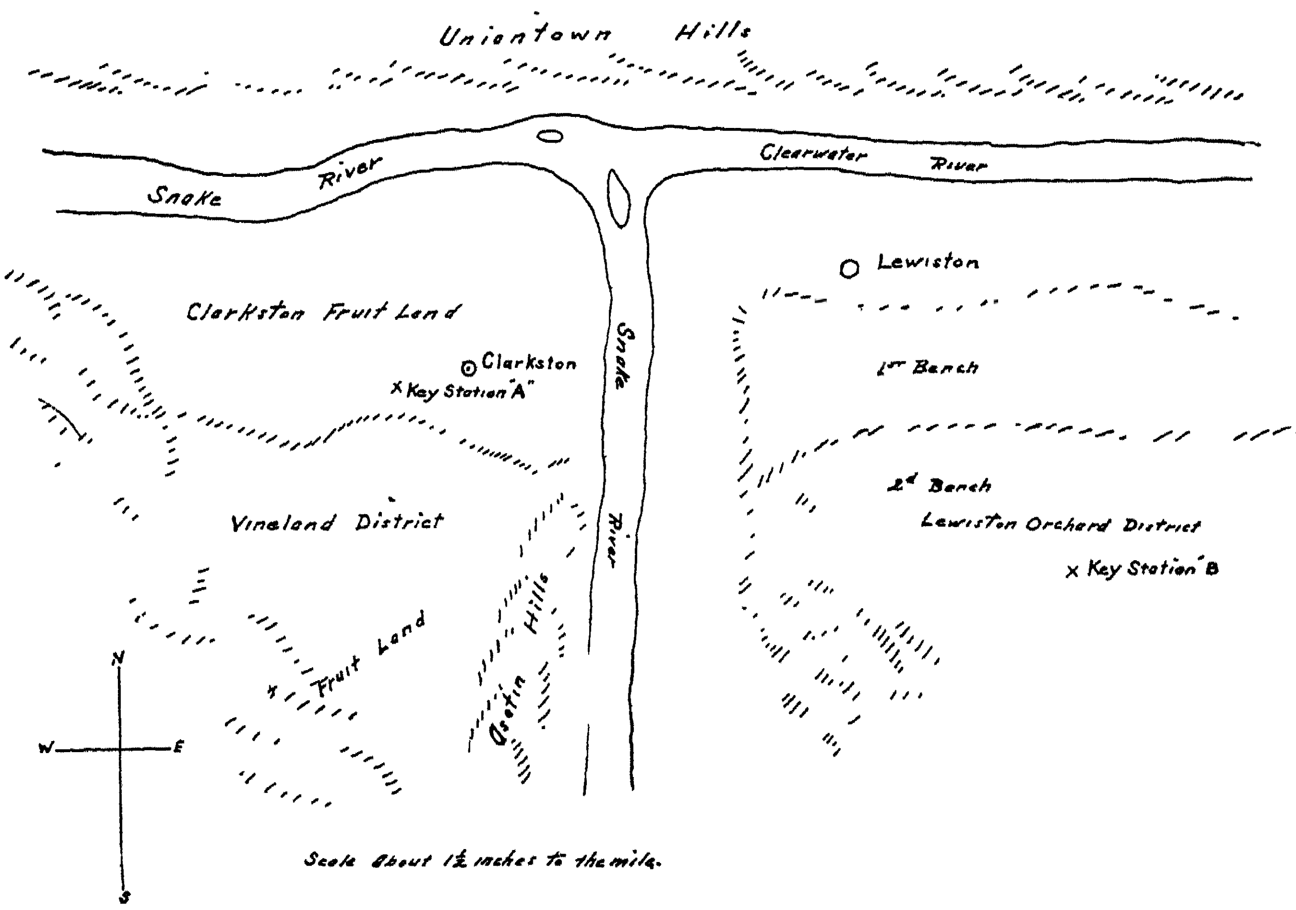


Fig. 5. Lewiston-Clarkston Fruit District.

—*After Reed.*

Owing, however, to the fact that orchardists have not taken up the idea of orchard heating to the extent that has characterized certain other sections, there has not been given the careful study to conditions here as elsewhere.

COLORADO

Grand Junction District

The most distinctive climatic feature of this section, especially of its lower valleys, is the comparative uniformity of the weather conditions from day to day. This is due to the high mountains, which practically surround the section and deflect the course of low pressure areas. A storm approaching from the west will usually cross the Continental Divide either to the north or the south of Colorado, where the height of the mountains is less. In consequence, the sudden changes that attend the passing of a low center are rarely experienced here. Severe cold waves, so common on the Eastern plains, are comparatively rare. There is, on the contrary, a tendency for a stationary area of high pressure to form over this region in winter, where it may remain for days, and even weeks, together. When one of these highs controls the weather, the sky is clear, the wind light, and of the mountain and valley type, the day temperatures are moderately high and remarkably uniform, and the nights cool, but seldom excessively cold, except when the ground is covered with snow, and where the air drainage is poor.

The annual mean temperatures range from 52.5 degrees, at Grand Junction, to less than 32 degrees, at the higher levels.

The night temperatures depend largely on the topography, air drainage exerting a greater control over this factor than does the absolute elevation. The mildest weather, in cold spells, is found where the night wind is the strongest, which is usually below the larger canyons. The comparative freedom from frost experienced by such regions has led to the development of an extensive fruit-growing industry.

The growing season, or interval when frost is not to be expected, varies greatly in different localities. Where longest (in the Grand valley), it extends from early in April to late in October; above 9,000 feet, frost may be expected every month. It is probable that the growing season is longer, in most localities, than is indicated by the attached frost table; a temperature of 32 degrees, which is taken as the standard, is not generally destructive to the staple crops.

Average Date of Killing Frosts

Stations	Length of record years	Last in Spring	First in Fall	Precipitation Av. Annual Inches
Cedar Edge	11	May 20	Sept. 23	11.02
Colbran	8	May 26	Sept. 24	15.16
Delta	13	May 16	Sept. 25	7.82
Durango	12	May 28	Sept. 26	17.51
Grand Junction	16	April 18	Oct. 18	8.74
Grand Valley	14	May 10	Sept. 29	12.30
Lay	9	June 16	Sept. 6	12.70
Mancos	10	June 9	Sept. 17	16.88
Meeker	14	June 12	Sept. 12	16.10
Montrose	10	May 16	Oct. 2	9.50
Pagoda	13	June 12	Sept. 3	18.26
Paonia	8	May 5	Oct. 3	12.16
Silt	12	May 21	Sept. 27	11.99
T. S. Ranch	8	April 27	Oct. 10	10.69

In the lower valleys the amount of sunshine is large, especially during the summer months; the greatest cloudiness is usually found in spring.

At the lower levels the wind movement is light, and is commonly of the mountain and valley type. The wind blows toward the mountains in the afternoon, and in localities attains considerable velocity. After sunset the wind subsides, and toward morning there is a light breeze from the mountains toward the lower levels. At the summits of the mountains the winds are generally from the west, and are frequently very strong in winter and spring.

The precipitation, up to the 10,000-foot level, is fairly represented by the table. It will be seen that, in the principal agricultural districts, the average is less than 15 inches, and is less than 10 inches over important areas. There is an increase in precipitation with altitude up to the highest points where observations have been made; an annual mean of more than 40 inches is indicated for certain localities.

By far the most important part of the precipitation occurs in winter and early spring, March and April being usually the months of heaviest snowfall. In the southern counties there is a pronounced tendency toward drought in late spring and early summer; June is often practically rainless. From the latter part of July until September, thunderstorms are common, but the precipitation is seldom heavy, except in the San Juan mountains

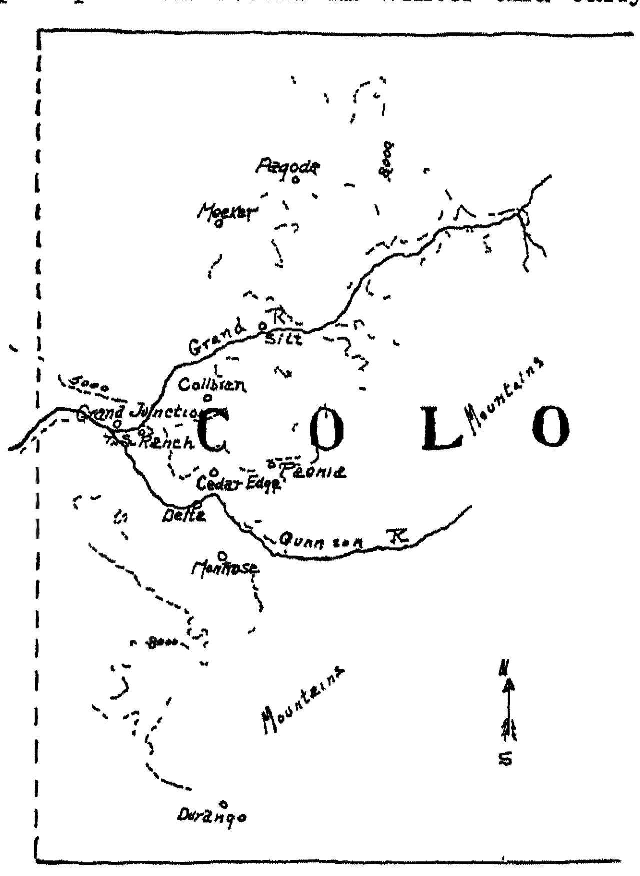


Fig 6 Grand Junction Fruit District, Showing Position of District Below the 8,000-foot level (U S Weather Bureau)

The snowfall in the lower valleys is light, and remains on the ground but a short time. With increasing elevation, the depth increases rapidly; near the mountain summits a total fall of over 30 feet has been observed in a single year At the very highest levels, practically all the precipitation is in the form of snow. Although the depth of snow varies much from year to year, the fall is so great that there are but few streams in this section that do not carry enough water for present needs, even in a dry season.

Frederick H. Brandenburg,
District Forecaster.

The Occurrence of Injurious Spring Temperatures in the Fruit Districts of Western Colorado

The fruit district under consideration embraces portions of the Grand and Gunnison valleys and branches thereof in Mesa, Delta, Montrose and Garfield counties in Western Colorado. The fruits principally raised are apples, peaches and pears. On account of variations in elevation, topography, air drainage, etc, fruit in some sections reaches a tender stage and is liable to injury (sometimes by the latter part of March), while that in other sections is still dormant. But, on the other hand, the later localities are the most likely to be visited by late spring freezes, and danger there is not entirely over until after the first of June.

The Grand valley fruit section is the lowest in elevation in the district and, in general, the earliest. Near the upper end it is narrow, and protected on the north by the Little Book cliffs, which rise more than a thousand feet abruptly almost from the edge of the orchards. In general the valley slopes towards the

Grand river, and down stream at the average rate of about ten feet per mile; so that air drainage is generally good, especially in the upper and middle portions. Also, in the narrow upper end mountain and valley and canyon breezes are naturally strongest and most efficient in stirring and warming up the air on frosty nights. So that Palisade, especially that portion close to the cliffs, is the earliest locality and the least likely to be injured by late spring freezes.

Outside the Grand valley the orchards are generally located on hillsides, sloping mesas or benches, or in narrow valleys, so that air drainage is usually good. For example, the fruit in the Paonia section is largely raised on the comparatively steep sides of the valley of the North Fork of the Gunnison river and in the narrow valley bottom, down which a wind usually blows during the latter part of the night and in the early morning, especially during clear weather.

Damaging spring temperatures are most likely to occur in the district when a high-pressure area of considerable energy advances in the rear of a low-pressure area across this part of the state from the northwest. If the high has advanced so far that the district lies well within it, local air drainage produces considerable differences in minimum temperature. But if the district lies in the region of circulation between the high and the low (particularly if the latter be vigorous and lie central over the southern part of the eastern slope of the Rocky mountains), temperatures will be more nearly uniform, and mountain and valley and canyon breezes are likely to be weakened or entirely counteracted. If the center of the high pass some distance north of the district, some cloudiness may be expected (especially if there be a low over Arizona), and temperature fall will be retarded. It has been found that there is no useful relation from the viewpoint of the forecaster, between the evening dew-point and the minimum temperature the following morning; although the quantity of moisture in the air affects radiation and hence the fall of temperature. The minimum temperature on an April morning at Grand Junction is usually about five eighths of the maximum temperature of the preceding day. If the air be very clear, still and dry, the minimum will be lower than the above relation indicates.

E. S. NICHOLS,
Local Forecaster, U S Weather Bureau.

METHODS AND ORGANIZATION IN FROST FIGHTING

P. J. O'GARA.

Efficiency of Present Methods

The present methods of frost prevention by means of fires and smudges, using the various types of oil pots and heaters, are by no means perfect. Perhaps in time we will have some method of orchard protection that is better than the oil pot now in use. It must be understood at the outset that the orchardist cannot afford to equip his orchard with apparatus of too costly a nature; it must be simple, or at least easily workable, and not too delicate for practicable use.

The protection of orchards from frost injury is not an experiment in Rogue River valley. A perusal of the records will show that the experimental stage in practical orchard heating has passed. A glance over the valley will show the large commercial orchards equipped with fuel pots for burning crude oil, distillate and coal, while others are protected by means of wood, which has proven very successful. A commercial orchardist who has for the past four seasons saved his crop, valued at more than $1,000 per acre, is not much in need of advice. If the cost of saving his crop is well below the maximum it would seem that, for him, his method must be the best. During the 1911 season of frosts the Rogue River valley orchardists did not experiment. In saving the crops from frost injury a safe approximation would put the number of fires used at fifty thousand. A large number of these were fuel pots burning crude oil and distillate, but there was also a very

large number of wood fires, which, though somewhat clumsier to handle, were none the less effective in obtaining the desired results, namely, saving the crops from damage.

Types of Orchard Heaters

In a commercial way, the types of pots used are the Fresno, Bolton and Hamilton. The Ideal coal pot was in use during the 1910 and 1911 frost periods. It is not the object of this article to discuss the relative merits of the different types of pots. The writer, however, has contended that the simplest type, which of course, will be the least expensive, is the one which will grow in favor with the fruit growers. A lard pail type is just as efficient as the Fresno pot with its row of holes near the upper rim. The Bolton pot has one disadvantage with respect to the arrester, or partial cover, which is placed over the mouth of the pot. No doubt in burning 28-degree test distillate this type of pot will work very nicely, but with crude oil or slop distillate the heavy coating of soot will tend to clog the openings and, in the course of a night's use, will have a marked effect in reducing the efficiency of the pot. It may even clog so much as to put out the flame. However, this pot, used open and without arrester, may be equal to the Fresno or lard pail type, and has proven so in actual test, since, burned

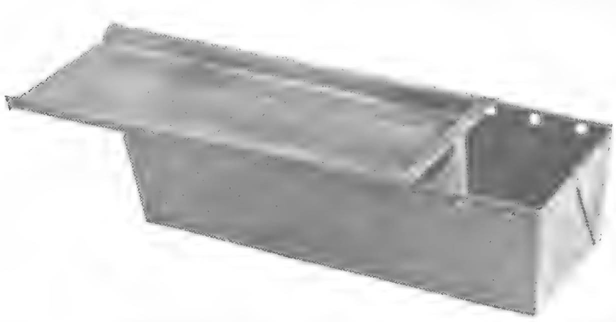


Fig. 1. Hamilton Reservoir Type of Orchard Heater.

that way, it is practically the same as the other two types. The Hamilton heater is so arranged as to increase or decrease the burning surface so as to regulate the amount of heat. This pot, which is made in the form of a rectangular trough, is not so saving of fuel as might be supposed, since there is often a tendency for the flame to burn back of the apron which hangs downward from the sliding cover, and which regulates, or is supposed to regulate, the amount of fuel burned. The Ideal coal heater is designed to hold 25 to 30 pounds of coal, and is very satisfactory so far as heating is concerned, but the fact that a great deal of time is required to lay the fires, or prepare the heaters, is somewhat against their use. There are a

Fig. 2. Oil Stove Type.

large number of heaters on the market, each one with its particular claim for efficiency; but as yet, with the fuels we have, it is a question as to what superiority one type may have over another. So far there has been no real efficiency test made in any part of the country where heaters have been used side by side under absolutely like conditions. It is the young orchard, which covers only a small part of the ground and traps little heat, with the fruiting area very low down near the ground, that is difficult to protect from frost injury. A test in such an orchard would really be worth while.

Fuels

The fuels used are crude oil, 28-degree test distillate, coal, wood (old rails and cordwood), straw, sawdust and manure, the latter being mainly used to produce a dense smudge. One of the greatest difficulties in the use of crude oil and

slop distillate is the presence of water, which tends to extinguish the flame or cause the pots to boil over. The presence of water in crude oil is due to the fact that water is forced into the rifled delivery pipes as a jacket so that the oil will flow readily. Crude oil cannot be forced through long lines of pipe without this water jacket. Outside of the fact that the crude oil often contains water, it has a very great tendency to deposit large amounts of soot on the trees, as well as tending to clog certain types of pots. Besides, a very large amount of residuum is left behind so that a second or a third filling will so coat the sides and bottom of the pot that it will hold much less oil in future fillings, and will, therefore, burn for a much shorter period. For instance, a pot that will hold one gallon when clean will not hold more than three-fourths of a gallon after having been burned two or three times. This is a very serious defect, and one that cannot be overlooked. The crude oil from the wells of the Pacific coast is unlike that of the East or Middle West in that it has an asphaltum base. No matter what the type of pot, a heavy asphaltum oil cannot be perfectly burned; that is to say, combustion is not complete. The heavy asphaltum base requires a much larger amount of oxygen than even the best type of pot can furnish, hence the large amount of residuum left on the sides and bottom of the pot. The oils of the East have a paraffine base and burn much better. At this time, however, it would seem impossible to bring this oil in so as to compete with the Pacific coast product. The freight charges would bring the price up to a point where its use would be prohibitive.

The distillate burns readily, leaves but very little deposit and does not tend to produce so much soot. This is what is called the 28-degree test. Its cost to the growers is very much above that of crude oil, and, therefore, was not used in 1911. The distillate used is known as "slop" distillate, and, although it was supposed to test 23 degrees, it has been found to test about 20 degrees, or perhaps a little more. This slop distillate proved to be very little, if any, better than the crude oil, since some of it contained water; and, besides, it tended to produce a great deal of soot. The amount of residuum left in the pots was in many cases nearly equal to that left by the crude oil. Both the crude oil and the slop distillate will eventually be replaced by a better fuel. We will either use a distillate, such as the 28-degree test, or the lighter paraffine oils of the East. The cost of crude oil laid down at Medford is about four and one-half cents per gallon, and that of the slop distillate six and one-quarter cents per gallon. The 28-degree test distillate, in 1910, cost the growers approximately nine cents a gallon. The greatest element of cost in obtaining these crude products is the high freight charge. Crude oil at the wells in California is worth scarcely two cents a gallon, and the distillates, which are refinery products, do not cost more than twice that figure.

By some of the fruit growers wood has been used for several years. That wood has been effective in preventing frost injury even when the temperature may run very low is proven by an examination of the orchards where wood was properly used. In connection with the wood one grower used a small amount of crude oil, which he threw upon the wood fires ranged along the east side of the orchard so as to produce a dense smudge just before sunrise. In the Hollywood orchard wood was also used for its heating effect, and the dense smudge was produced by adding quantities of stable manure to the wood fires. An examination of the orchard showed that the method worked very well. In other orchards the same scheme of using wood and manure was carried out, and excellent results were obtained. In some very small orchards sawdust and shavings, put into large paper sacks and saturated with crude oil, also proved to be quite effective. These fires burned from six to seven hours, giving off a consid-

erable amount of heat and a very dense smudge.

Methods of Lighting

The methods of lighting the different fuels are not difficult. With crude oil and distillate a small amount of gasoline or kerosene, squirted from an oil can onto the surface of the oils, was easily ignited by a torch. In most cases the torches were home-made affairs, but were none the less serviceable. A man could easily light the pots as fast as he could walk. The cover on the pot was quickly thrown off, a few drops of kerosene or gasoline spilled on the surface of the oil and the torch quickly applied; this is the work of but a moment, and scarcely needed a stop on the part of the operator. In order to ignite the wood it is necessary to pile it in a particular way Fine material is not absolutely necessary if the wood is dry. A kerosene can and a torch are all that is needed. A small amount of kerosene spilled on the wood, which is piled "dove-tail" fashion, and the torch applied will easily start it. During the past season of frosts some difficulty was experienced in lighting the wood on account of the fact that during the week previous there had been a heavy precipitation amounting to about 1.27 inches. However, this exigency was overcome by using kindling and a little more kerosene and some crude oil. In using wood the particular thing to keep in mind is that it should be dry. Frost conditions are almost certain to follow a heavy rain, and this was particularly true during this season.

Planning the Frost-Fighting Campaign; Number of Pots or Fires per Acre

The work of planning the frost-fighting campaign really begins the previous fall. If crude oil or distillate is the fuel to be used the pots must be purchased so as to be on the ground not later than the last week of March, even though frosts do not usually occur before the first week of April. The fuel oil is also ordered in tank cars of 6,000 to 10,000 gallons each, and upon delivery is emptied into large storage tanks on the ranches. These tanks are usually of concrete, and are placed upon an elevation so that the work of unloading the delivery wagons, as well as the subsequent filling of the tank wagons for delivery to the pots in the orchard, is effected by gravity. Pumping crude oil is rather an impossible task, or a difficult one at best, especially when it is cold. Distillate is easier to handle, but the gravity method of handling it is much quicker and saves a lot of work. The method of filling the pots is usually by means of a large hose attached to a gate valve on the delivery tank. Another method is to use large buckets with which to fill the pots. When this method is used the hose is dispensed with, and only a large gate valve or molasses gate is used. Six men working eight hours can easily fill 2,000 pots. The number of pots to be used per acre will vary within wide limits. Large spreading trees, with the fruit borne not lower than four feet from the ground, may easily be protected from the most serious freeze we have experienced during the past four years by using sixty-five to seventy pots per acre. However, it is to be understood that the sides or outside rows should be reinforced by at least two rows of pots. This is especially true of the sides of orchards in the direction of the prevailing wind. However, it is a good plan to reinforce all sides so as to meet any emergency. During the 1911 season sixty-five pots burning slop distillate saved the Potter and Goold pear orchard when the temperature outside of the orchard registered 20 degrees by a tested thermometer. The results in this orchard are so clear that there is no mistaking the effectiveness of systematic orchard heating. A few pear trees of the same variety standing about ten rods outside of the heated area lost their entire crop.

The number of pots to be used will depend upon the geographical position of the orchard, its elevation, and the size and height of the crop bearing portion of the trees. In a young orchard of per-

haps four to eight years of age it will take two or three times as many pots as in an old orchard with spreading limbs almost touching each other and effectively trapping the heat. A perfect knowledge of the frost possibilities of any particular tract will guide one as to the amount of protection necessary. It would be safe to say that from 150 to 200 pots will be needed in very young orchards situated in what are known as "cold spots." Every orchardist knows, or should know, where these spots are. When wood is the fuel to be used it should be secured early, and must be dry. Most of the firing done by wood has been with old rails which were well seasoned and burned without difficulty. Cordwood has also been used to a somewhat less extent, but, nevertheless, with entire satisfaction. Wood is very clumsy and much in the way, and there is no doubt that its use will be abandoned in the near future. Some growers, however, are of the opinion that wood is the best fuel, and it is quite probable that for small tracts its use will be continued. There is really no difficulty in handling it if properly placed, but for large tracts I would rather think its use to be quite out of the question. The element of time consumed in placing it as well as the space it takes up in the orchard, thus interfering with cultivation, argues against its use. The number of wood fires necessary for large trees may be all the way from 25 to 50. The fires should not be large, since large fires tend to produce convective air currents and may be more harmful to the orchard as a whole than the same number of small fires. In most orchards it was found that the temperature could be raised six to ten degrees. Manure, sawdust and rubbish are used mainly to create a smudge, and are of practically no value in raising the temperature. In using wood these materials are often quite an additional help in holding the heat generated by the burning wood. It often happens that the temperature cannot be kept above the danger point; if this happens toward morning the smudge is beneficial in protecting the frozen blossoms and fruit from the morning sun, which would tend to thaw them too rapidly. It is not the freezing of the fruit that causes the injury; it is the thawing. Blossoms may be frozen solid for several hours and not be injured if thawed out very slowly. Freezing causes the water to be abstracted from the cell protoplasm. The protoplasm has taken this water up from the soil very slowly. If the water which has been abstracted from it can be returned very slowly the cell will recover its former activities. No matter what fuel is to be used a plentiful supply should be distributed in the orchards. Even if fifty pots will do the work it is better to have one hundred or more for each acre even in an orchard of old trees. The same may be said of wood. It is only necessary to light as many fires as will keep the temperature above the danger point. It is as great a mistake to light too many fires as it is to light too few, for the reason that burning unnecessary fuel may cause a shortage at a time when lack of fuel would mean a total loss. Once the temperature goes very much below the danger point it is hard to raise it, and if this happens very near sunrise a smudge dense enough to protect the frozen blossoms may be hard to secure or to keep hanging over the orchards. It is best to take no chances.

Thermometers and Frost Alarms

Good thermometers should not be overlooked, and no fewer than two or three per acre should be used for the best results. These instruments should not be the very cheap kind, although it is not advised that they should be very expensive. All thermometers should be tested and the correction for the different points on the scale carefully marked so as to be easily read. A thermometer with its correction is just as good as one that reads absolutely true. As a matter of fact, the very best thermometers are not accurate, and must have corrections made for different parts of the scale. For the orchardist, it is usually sufficient to know within at least half a

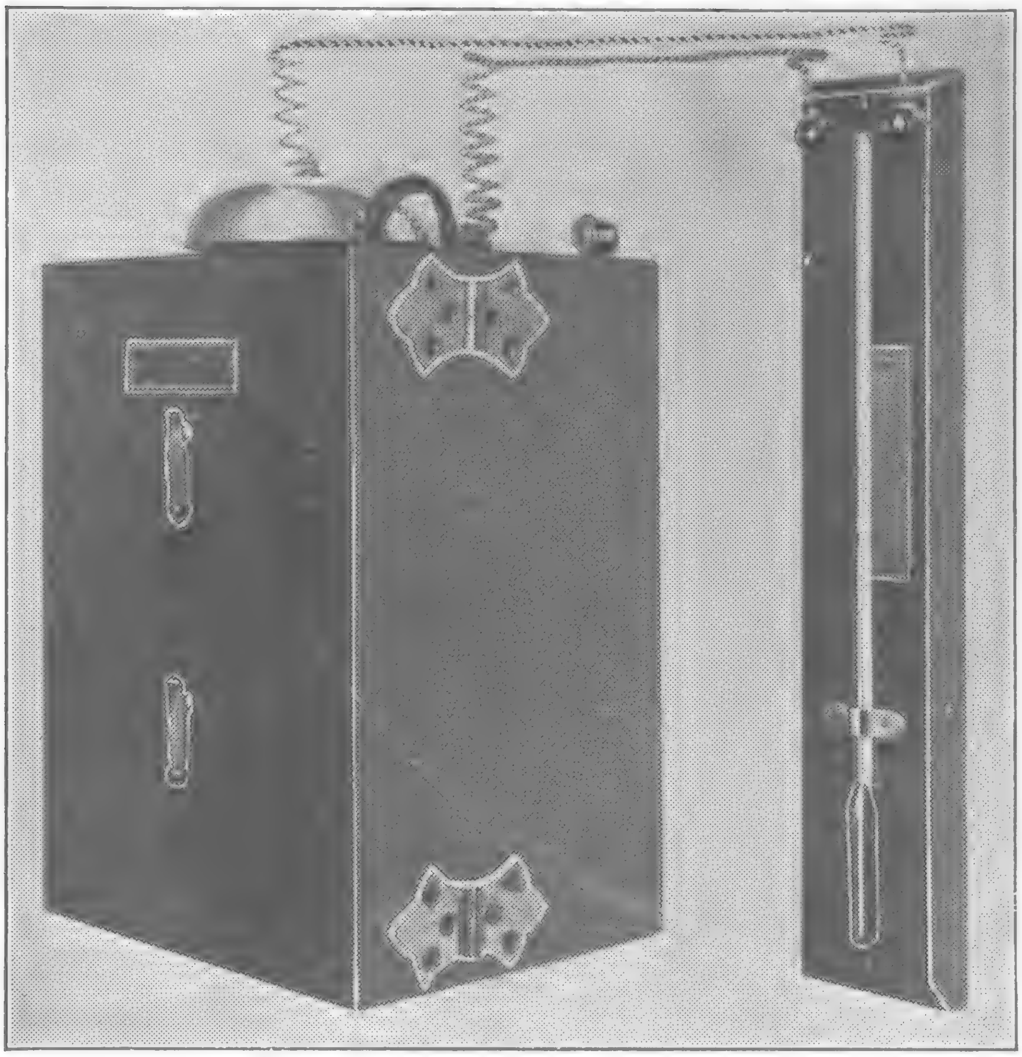


Fig. 3. Carbondale Frost Alarm.

degree of the correct temperature reading, since he is quite certain to keep on the safe side at all times. Besides the thermometers in the field, the frost alarm thermometer, which is designed to awaken one when a certain temperature has been reached, may be more or less advisable. Of course, all a frost alarm thermometer can do is to indicate that a certain temperature has been reached. It is usually made to ring at, say 33 or 32 degrees, and does not necessarily indicate that dangerous temperatures will follow. During the past the local forecasting station has indicated very nearly the hour when it would be necessary to fire as well as forecasting the possible temperature, so that with this in mind those who had no frost alarm thermometers got along very well with a good alarm clock. It would be a serious mistake to begin lighting up without knowing whether or not the temperature would go below the danger point; this is where the local forecaster's work is of greatest value.

Physics of Orchard Heating

In all that has been published no figures have been given to show what a certain quantity of fuel will do under actual conditions. Of course, this cannot be accurately stated, but we can give what we might expect under set or ideal conditions. We will take as an instance the protection of a pear orchard with the trees set 25 feet apart on the square. With the trees in good bearing the maximum height at which fruit is borne is not more than 15 feet, and is usually much below this. We will consider each pear tree as growing in a cubical space which, under normal atmospheric pressure at our elevation above sea level (1,400 feet) and at a temperature of 32 degrees Fahrenheit, contains, in round numbers, 600 pounds of air. If this space contained 600 pounds of water it would require 600 British Thermal heat units to raise the temperature through one degree Fahrenheit, but since the space is filled with air under the above conditions it will

take only one-fourth as many heat units to raise the temperature one degree within such space. If one oil pot is provided for such a space, that is, one pot per tree, we will have 70 pots per acre. Each pot will have to take care of 600 pounds of air. Most of the crude oils used as fuels for orchard heating in this district average nearly eight pounds per gallon, and it has been found by laboratory test that a pound (one pint) has a calorific, or heat value, of about 18,000 British Thermal units. Some oils test higher, some lower. In burning tests in the field under actual frost conditions it has been found that for the lard pail type of pot, such as the Bolton, with or without perforations in the upper rim, two pounds of oil are consumed per hour. Naturally, the oil consumption is greater when the pots are first lighted, and this is also true where there is considerable air movement. Of course, combustion is not perfect, hence the total calorific power of the oil is not utilized. However, since we are dealing only in round numbers we will suppose that combustion is fairly complete. Then two pounds of oil will give off 36,000 heat units per hour, or 600 per minute. Now, since the cubical space occupied by one pear tree contains about 600 pounds of air at our average pressure and at a temperature of 32 degrees, it means that each minute 600 heat units are expended on 600 pounds of air, or sufficient to raise the temperature of this mass of air through four degrees Fahrenheit. We have not taken into account the small amount of water vapor present under frost conditions, as this would not appreciably affect the calculation. It is supposed, of course, that the air is not in motion, and that there is no radiation of heat beyond the imaginary cubical space occupied by the tree. In actual practice we know that radiation does take place, and that there is usually some air movement. Of course, this is offset to a very great extent in old orchards by the trapping of the heat and the braking effect on wind currents, due to the extended branches, but in young orchards, covering but a small ground area, air movement and radiation are practically the same as in the open. There is one thing to be said, however, under our conditions. Upward radiation of heat is not so great as one would suppose. During the past four years a large number of observations have shown that the temperature of the atmosphere during a freeze rarely reaches the danger point at a height of 15 to 20 feet above the level of the valley floor. Since this is true, there would be no tendency for heat to be radiated from below into this upper stratum of warmer air—in fact the heat movement would rather be the reverse, that is, downward. As previously explained in another part of this article, frosts which occur in this valley are due to depression rather than elevation. It is the cold air coming from very high elevations in the surrounding mountains that flows downward into the valley floor, tending to push the warmer air upward. For a while radiation from the ground, which has taken in heat during the hours of sunshine, tends to warm this cold air. But to return. We have shown that with no wind and with one oil pot for every pear tree the temperature may be raised four degrees per minute within the calculated space. But if the air moved only 100 feet per minute, or a little more than one mile per hour, the temperature could never rise more than one degree above the temperature of the incoming cold air. At four miles per hour it could rise but one-fourth degree. This would be true only in the outside tree rows, on the side from which the air movement comes. For all the rows beyond the outside row, some of the heat units generated in the first row would be added to the heat generated inside. This interesting calculation shows that an orchard in the form of a solid square would not be so difficult to save from frost injury as one of the same area of only a few rows. During the past four seasons this has been demonstrated in several of our orchards. In the Potter and Goold orchard the main body of pears has easily been saved when tem-

peratures ran as low as 20 degrees outside, while two rows of pear trees extending beyond the main body of the pear orchard but surrounded by apple trees fully larger lost most of their crop, although protected by a greater number of fires. No orchard heating device on the market effects perfect combustion of crude oil or distillate, therefore the theoretical figures given above are hardly approached in practice. In some tests carried out in this district the beneficial results of certain devices did not show up when it came time to harvest the fruit. The time to tell whether orchard heating has been successful or not is when the fruit is picked and brought to the packing house. Just to make fruit stick upon the trees is not protection. A misshapen or frost marked fruit is not commercial either for fancy box trade or for the cannery. Canneries do not want badly frost marked pears, as the waste is too great. In the above calculation we have considered only crude oil, but practically the same figures will apply to all the heavier distillates. It might be well to mention something in regard to other fuels we have used in this district. A pound of dry pine wood, under perfect combustion, will generate about 6,000 heat units. A pound of oak contains practically the same number of heat units. Coal, under the same conditions, has approximately 12,000 heat units. The average weight of a cord of pine is about 2,000 pounds, and that of oak is about 4,000 pounds. These figures are, of course, only approximate, but they will serve as a basis for calculation in case anyone should desire to use wood or coal for orchard heating purposes. The use of wood and coal has been discussed in previous articles, also in United States Farmer's Bulletin No. 401, which may be obtained by addressing a letter to the United States Department of Agriculture, Washington, D. C.

Meteorological Instruments

Wherever it is found necessary to protect orchards from frost injury each fruit grower should provide himself early in advance of the season for firing not only with fuel, pots or other heating apparatus, but also with a sufficient number of thermometers. It is also advised that each fruit grower should have a good maximum-minimum theremometer. A dew-point apparatus or psychrometer for determining the dew-point temperature, accompanied with tables, would also be a valuable part of the equipment. The dew-point apparatus is simply two fairly good thermometers fixed together, with one of the bulbs covered with linen. A string tied into the rings of sufficient length to whirl the instrument completes it. In using the instrument, wet the covered bulb and whirl rapidly so that evaporation will take place from the wet surface. When the mercury in the wet bulb thermometer cannot be lowered any

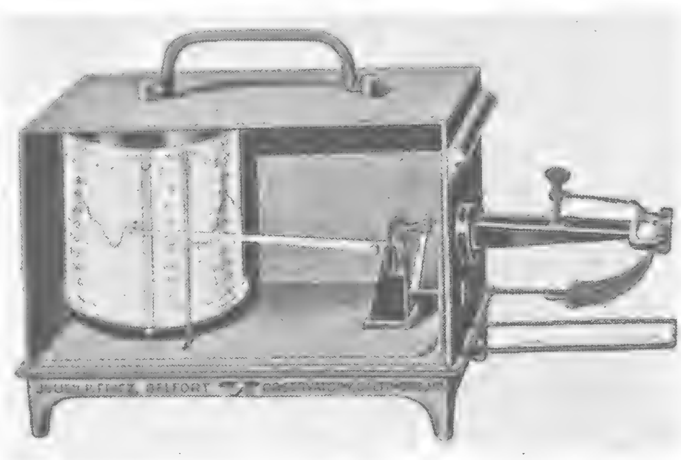


Fig. 4. Thermograph, or Self-Registering Thermometer.

further it should be read simultaneously with the dry bulb theremometer. The readings are referred to tables (See U. S. Farmer's Bulletin No. 401) which give the dew-point temperature. The dew-point temperature, when found in the early evening, is usually in close agreement with the minimum temperature the following morning, providing the sky remains clear and there is no wind. This is true during only a part of the year. The following data taken from the records made by the Medford United States Weather Bureau station for the years 1909, 1910 and 1911 will show that the above statement holds good. It will be noted that the dew-point temperatures observed, both when frosts occurred and when they did not, agree fairly well with the minimum temperature:

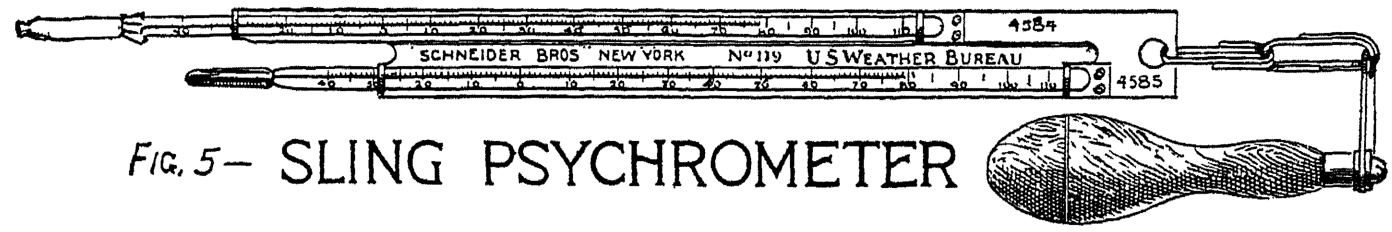


FIG. 5— SLING PSYCHROMETER

Year	Date	Time	Dew-point degrees	Temp. during night degrees
1909	April 19	....6:45 p. m	29	29
1910	April 3	....6:30 p. m.	27	27
1910	April 9	....6:30 p. m.	44	44
1910	April 11	....6:30 p. m.	41	40
1910	April 13	....6:30 p. m.	29	26
1910	April 25	....6:30 p. m.	42	44
1910	May 2	....6:30 p. m.	40	42
1911	April 14	....6:30 p m.	23	22
1911	April 25	....6 .30 p. m.	41	43½
1911	April 28	....6:30 p. m.	31	27½

These figures are taken at random from the records and represent pretty fairly all the data which have been recorded during the above years throughout the frost season. The minimum temperatures are for such nights as remained clear and with very slight air movement, which was from the south. An aneroid barometer is also a valuable instrument. By carefully noting the movement of this instrument one may readily learn to predict with more or less certainty the kind of weather to be expected. With the pressure high the chances are that frost may be expected and the reverse when the pressure is low. In making readings with all meteorological instruments there should be a set time for observations. Random readings, taken at odd times; are of very little value. A careful record will surely repay the observer many times for his trouble. It would be a very fine practice for each grower to be able to tell what were his maximum and minimum temperatures, barometer, wind direction and estimate of velocity, dew-point temperatures and rainfall for each day in the year. This data would not only be valuable to himself, but to the district as a whole. Lastly, whenever it is possible get the weather from the nearest United States Weather Bureau station. The local observer is usually better equipped to tell what weather conditions are likely to be expected and what emergencies are to be provided for than anyone else. He is also able to tell what temperatures are injurious to the several kinds of fruits through the season. Injurious temperatures are not the same for all varieties, nor are they the same for any one variety during different stages of its growth.

Fruit Garden

In all undertakings of this sort it is very important to have a clear and intelligent idea of what is to be done. There are so many matters which have to be adjusted to one another that the essential items are sure to be overlooked, unless the project is systematically developed. The garden-plan should be made as carefully as the plan for a house and with as much attention to detail as the architect gives in his finished drawings. Every tree and bush should be located and its species and variety designated. After this much has been done, it will be easier to decide on drainage, cultivation and management. Unless these things are done, all other questions are settled by guesswork.

There is no end of entertainment for winter evenings in this matter of making a design. Many families spend years of pleasant recreation in planning houses which they never build, but gardeners' plans are cheaper and just as interesting.

We all know that the common city lot, or suburban garden, is not an ideal place for fruit growing, agriculturally and geologically speaking. The soil is apt to be made up of ashes and the drainage secured by a varying admixture of tin cans and discarded umbrellas. While such soils do not appear under terms of high praise in the agricultural survey, they are not altogether impossible to the determined city gardener; and the first term in their utilization is that of drainage.

It may be difficult for a perfect ignoramus to tell by looking at a piece of land whether it is drained enough or not. Yet a good deal can be told by observation. If water stands in pools on the surface for any length of time after a rainstorm, it indicates that the drainage is poor. If the soil is left very hard and brick-like when it dries out after a rain, better drainage is required.

The best way to secure drainage where such treatment is required is by means of porous drain tiles. These must be furnished with some satisfactory outlet, either into the sewer or open ditch. They should be laid through the soil at a depth of two to four feet, and the branch drains in the small garden should be thirty feet apart.

Good drainage is essential to success with a fruit garden.

Preparation of the Soil

Considerable care will be needed to prepare an unsuitable suburban lot for a successful amateur garden. In many cases the city dweller or suburbanite is compelled to make the soil first. Perhaps he has to buy it. In case the place has no good soil on the surface, it will be necessary to get a supply, even though it has to be bought from contractors. For our purposes we need a strong, gravelly soil, without too much clay. If we can get surface soil containing vegetable matter, humus and loam, so much the better.

The best preparation to be given to soil comes through drainage and cultivation. The ideal way to prepare the garden is to spade it up deeply—just as deeply as possible. This work should be done early in the spring. Then the land should be planted with some crop which will make a vigorous growth. Cow peas, soy beans, crimson clover and buckwheat are the best crops, each one having its particular advantages. Any one of these will add humus and life to the soil. Suppose a crop of this sort has been grown the first year; it will be allowed to stand through the winter and will be plowed or spaded in the following spring. The second year the ground should be planted to some crop requiring high cultivation, such as beets, cabbage or potatoes. A liberal allowance of barnyard manure should be given, and the hoe and cultivator frequently applied. The third year the ground will be in excellent condition for planting. This program will be effective on everything except the most refractory soils. On better land the preparation may be reduced to a single year, and on good land the soil may be dug up and planted to fruit trees the first year.

Plant Food

Backyard lots are apt to be deficient in available plant food. There are usually enough chemicals in the soil to grow trees, but they are not accessible and digestible. The deficiency is to be made good with fertilizer. In beginning the garden, no fertilizer can be compared with well-rotted barnyard manure. This should be used liberally. A garden 50 feet square would usually be able to use two cords of stable fertilizer to good advantage at the beginning of its cultivation, and might have one cord annually for the first two or three years.

As soon as the work is well under way, soil in good condition, and the trees beginning to make some growth, the amount of barnyard manure should be materially reduced, or cut off altogether. At the same time, the amount of chemical fertilizer should be increased. For smaller gardens it will be found best to buy ready-mixed fertilizers, depending a good deal on the advice of the best dealers. Such dealers can supply mixtures suitable for fruit trees and are willing to give information regarding amounts to be used, times of application, etc.

Getting the Trees

Varieties to be planted should be selected, as far as possible, on the basis of the gardener's own taste, corrected only by what you are able to learn regarding their probable success in the locality. Of course, if you know nothing about the different varieties of peaches, plums or apples, you would better consult the ex-

pert, and, in this case, the professors at the agricultural college will give unprejudiced and reliable advice. The best nurserymen can be relied on in this way, also; since it is to their interest to supply only such trees and varieties as will succeed and please their customers. But avoid, always, at all times, the itinerant tree peddler.

In nearly all cases trees should be ordered in the fall, and they should be delivered and planted in the spring.

A great deal of superstition surrounds the practice of tree planting. Many persons imagine there is some hocus-pocus about it. In many of the horticultural books there will be found most elaborate directions, amounting almost to religious ceremonies, for the planting of trees. Much of this is unnecessary and nonsensical, as is shown by the fact that commercial tree planters do the work with low-priced, ignorant help, and still accomplish it very rapidly. I have seen a gang of four men, no one of them able to read Caesar, plant 800 trees in a day—and every tree grew. A very able American horticulturist has recently advocated a new and striking method of tree planting, which consists in cutting off all the roots and most of the top from every nursery tree, and inserting the stubs in holes driven in the soil with a crowbar. The most amusing thing about this proposition is that it succeeds admirably in most cases. Wherefore, let us say that young fruit trees may be planted with every prospect of success if the most ordinary common sense is exercised. Broken roots should be cut away, and the top of each tree should be liberally pruned before setting. Water or fertilizer should not be put into the hole with the tree roots. Under most circumstances, both should be omitted from the process altogether, though either one may be applied in small quantities to the surface about the tree after it is planted.

Management After Planting

In order to make the fruit tree succeed, constant and intelligent labor is required. The garden must be well tilled, especially during the early portion of the summer. Tillage ought to cease about July 10th in central latitudes. Trees ought to be pruned year by year. Several books have been written about pruning, and I hesitate to condense their information into a single paragraph. Some regular treatment, such as spraying, should be planned for the suppression of insects and fungus diseases. Information on such matters can be secured from books, or from experts, who may be consulted without expense. The annual supply of plant food is to be kept up. Where trees are grown in dwarf forms or on trellises, there is more or less training to be done.

Dwarf Fruit Trees

It will be quite wrong to pass over the subject of dwarf trees in the discussion of city lot fruit gardens. On all small places the dwarf trees are of great advantage. Their principal superiority in this case lies in the large number of them which can be put on a small tract. Dwarf fruit trees bear fruit exactly like the ordinary trees, and of the same varieties, such as Baldwin apples or Anjou pears. In size they may stand anywhere below the ordinary fruit trees, but, of course, for backyard gardens the smallest sizes are desirable.

These dwarf fruit trees are secured by budding or grafting the ordinary varieties upon diminutive stocks. For example, the smallest dwarf apples are grafted upon so-called Paradise stocks, these being simply very diminutive apple trees grown from cuttings. Dwarf peach trees are secured by budding the ordinary varieties on small slow-growing plum roots. Dwarf pears are secured by budding the pear scion upon quince roots. Unfortunately, the demand for such things is not great enough in this country to insure a constant supply. Dwarf pears and dwarf apples can be secured from leading American nurserymen, but it is almost impossible to get dwarf peach or plum trees without sending to Europe or propagating them at home. This business of home propagation is worth try-

ing, however. It is quite as interesting as fruit growing itself, and is capable of furnishing liberal education to the boys, not to mention the girls

Some other advantages of dwarf fruit trees will be fairly plain without argument. They bear fruit at a much earlier age than the ordinary trees, often yielding good crops two or three years after planting. The trees being small are easier to care for, easier to prune, easier to spray.

It must not be understood that it is cheaper to grow fruit in this way, or that the dwarf trees are to take the place of standard trees in money-making enterprises. We are talking of them now only as a first-class entertainment; but they do form an almost essential feature in the design of a city fruit garden.

Some Specific Suggestions

Our country is so large, and its climate and soils so diversified, that we cannot possibly lay out one fruit garden which can be adopted everywhere. Points to be kept in mind are: (1) that a considerable diversity of fruit should be put in every home garden; (2) that these should be chosen according to personal taste; (3) that due attention should be paid to the adaptability of all varieties to the soil and climate; (4) that varieties should ripen in succession; (5) that varieties of fine appearance and high quality be chosen in preference to those which are commercially successful.

FRANK A. WAUGH,
Amherst, Mass
(Courtesy Woman's Home Companion.)

*Fruit Trees—Winter Killing of

About once in each decade, and sometimes oftener, a severe winter occurs in which an unusually large number of fruit trees are killed. An examination of the orchards after such winters shows many irregularities as to the extent of the injuries in orchards differently located and managed. Some varieties of fruits are uniformly less hardy than others, and the winter injury to these sorts may be traced directly to their greater tenderness. On the other hand, trees normally perfectly hardy in a locality may suffer serious injury or be entirely killed during such "test" winters, while other trees of the same varieties in the same orchard may escape injury entirely. During the prolonged cold winter of 1903-4 great losses were suffered by orchardists in the Lake Erie peach belt. Some orchards were entirely destroyed; others were apparently uninjured and came through the winter in a vigorous, hardy condition; and still others, while suffering severely, yet contained sections, rows or parts of rows, or individual trees that came through the winter uninjured.

Many theories were advanced by the orchardists as to the cause of these anomalies, and as many contradictions appeared. The theory of insufficient drainage, which might be advanced as the cause of the injury in one orchard, would receive direct refutation in the next. If an orchard on elevated ground escaped in one instance it might be partially or entirely killed in another. In order to learn the cause of these irregularities, the horticulturist of the Ohio Experiment Station and his assistants visited both injured and uninjured orchards in Catawba island and the peninsula of eastern Ottawa county, in Ohio, and made a thorough study of the matter, reporting the results of their investigations in a recent bulletin of the station.

Their investigations show that while a general or direct cause of the injury was, of course, the severe and long-continued cold, the specific causes of the varying degrees of injury were exceedingly numerous. Generally speaking, it was found that where the vitality of the tree or orchard had been lowered by any cause whatever during its previous history the chances of injury to the tree by the cold were by so much increased. Factors observed in different orchards which contributed to low vitality in the trees were an insufficient degree of fertility, a low physical condition of the soils, prevalence of San Jose scale, leaf

* Compiled from Ohio Experiment Station Bulletin 157.

curl, peach tree borers, extremely dry condition of the ground in some sandy and gravelly ridges, "water-logged" soils, etc.

Injury on Bare Ground

There was a marked contrast in the extent of the winter injury on bare soils —soils given clean cultivation—and on covered soils. The bare soils froze deeper and the injury was much greater than on soils covered with a mulch or other material. The greater depth to which bare soils freeze in winter than covered soils was brought out in an experiment made at the station. A plat of peaches in an exposed situation was selected and a strip of sod 10 to 12 feet wide removed from one row, leaving the bare surface of the soil fully exposed to the cold. Another row alongside was left in grass which had been clipped and allowed to lie upon the ground. † When the sod was removed the ground froze to a depth of 18 inches, while under the thin sod covering of grass and weeds in the other row the ground froze to a depth of about eight inches. The trees in the bare ground "were very slow in starting into growth the following spring of 1904. All of the trees in this row were seriously injured by the cold, many large branches dying, while in one case the entire tree was so badly injured that but few leaves appeared throughout the season, and these upon shoots so feeble and slender that the tree might well be considered dead. Later in the season, however, some of the trees rallied slightly, though all showed a serious lack of vitality. The trees in the sod * * * did not suffer in the least degree—all making a healthy, uniform growth during the season of 1904."

Value of Cover Crops

The value of an annual cover crop as compared with clean cultivation was found in an orchard 18 years planted, one-half of which had been cultivated during the first half of each season and then sown to crimson clover, while the other half was given clean cultivation during the growing season. "Upon the clean culture area there was a much greater percentage of injury from the cold of the winter than upon the crimson-clover section. Where the clover crops had been grown and plowed down the trees showed remarkably healthy, heavy, dark-green foliage, contrasting sharply with the yellowish, sickly foliage of the clean culture plat." Another grower in the injured peach region stated that "not a single orchard or section of an orchard of which he knew, that had received even a light dressing of barnyard manure within the last year or two, had suffered noticeably from cold."

Injury in Scale-Infested Orchards

A 13-year-old orchard of 660 trees was found located on shallow limestone soil covered with a dense, heavy growth of bluegrass. The San Jose scale had wrought havoc in the neighborhood, but it had been kept under control in this orchard by spraying. As a result, not a tree in the whole block was killed by cold. Across the road from this orchard was another, located on similar soil and also in sod, but in which the scale had not been controlled. "The story is told in two words—entirely dead."

Injury from Leaf Curl

Another instance is cited in which an orchard was sprayed in the spring of 1902 for the control of the scale, with the exception of three rows through the middle, which were overlooked. As a result, the scale increased rapidly during this season on these unsprayed trees, and they were also attacked by leaf curl, which practically defoliated them. The whole orchard was sprayed in 1903, nevertheless the trees had been so weakened by the leaf curl of the preceding year that the good care given them in 1903 was unavailing, and every tree in the three rows was killed, while every tree on either side of them which had been sprayed came through the winter sound, vigorous and healthy.

Benefits from Banking Trees

A simple, easy, and very effective method of preventing winter killing of peach trees was observed in the orchard of one

† See United States Department of Agriculture, Farmers' Bulletin 202, p. 11.

grower. Just before winter set in this grower hauled manure to the orchard, but instead of scattering it beneath the trees in the usual way he banked a very few forkfuls immediately around the stem of the tree. When the supply of manure ran out peat or earth was hauled into the orchard and banked around the stems of the tree in the same manner.

"The results from the use of these materials were uniform, and, surprising as it may seem, every tree that received this simple treatment survived the winter without the least injury from cold, while the few trees and sections of rows left here and there unbanked and serving as 'checks' in the experiment died almost to a tree." Another orchard of some 500 trees a little farther to the west of this orchard, "which had received the same high culture and good care, with the exception of the simple banking process, was almost a total loss." The trees in these orchards were extremely vigorous and had made a rank growth, which made them peculiarly susceptible to injury by freezing.

Orchards in Sod

On the same farm trees on a piece of ground which was so stony that it could not be cultivated and which was kept in bluegrass sod, with a heavy mulch of coarse material, such as cornstalks, barnyard manure, etc., about the stems, according to the true "sod-and-mulch" method, came through the winter without injury.

These investigations bring out strikingly the necessity of such continuous and thorough cultural practices in the orchard as shall maintain the trees at all times in a vigorous, healthy condition. The fertility and vegetable matter of the soil must be maintained by the addition of manure or the growing of cover crops. Spraying to control insect pests and fungus diseases must be thorough and unremittent. Trees on undrained or very rich soil, trees weakened by over bearing or by borers, all alike invite winter injury. Cover crops and mulches protect the ground from deep freezing and resultant winter injury. Sod serves the same purpose Banking up the trunks with a few shovelfuls of manure or earth appears to have a marked favorable influence.

Fruit as Food

Edible fruits show the greatest range in form, color, and appearance and are found in almost countless varieties; yet from the botanist's standpoint all our fruits are the seed-bearing portion of the plant. The edible fruits of temperate regions fall into a few groups—stone-fruits, like cherries and plums; pome fruits, like apples and pears; grapes; and berries, like strawberries, blackberries, and currants. There are several products, such as muskmelons, cantaloupes, and watermelons, sometimes classed as fruits and sometimes as vegetables, which, of course, would not belong to any one of these groups. Tropical fruits are not so easily classified, though the citrus family (oranges, lemons, etc.) includes many of the more common sorts.

There are a few vegetable products which are not fruits in any botanical sense, but which by common consent are included in this class of food products since their place in the diet is the same. The most common of these products is rhubarb, and there are few uses of fruit which the acid rhubarb stalk does not serve. Angelica stalks, which are candied and used for making cakes and confectionery, are much less common, though the total amount used is large. It is certainly more natural to include preserved, candied, and crystallized ginger root with candied pineapple, candied cumquats and similar products than with any other class of food materials, and old-fashioned candied sweet flag root may also be mentioned in this connection.

Wild and Cultivated Fruits

In an account of the first Virginia colony it is stated that the Indians ate wild mulberries, crab apples, and huckleberries, but nothing is said of their cultivating fruits, though they raised corn and other vegetables. Wild fruits have been part of the diet of primitive man whenever obtainable, and no one can say with certainty when wild varieties were first cultivated, but it must have been early

in the history of the race, since such fruits as apples and pears have been under cultivation so long that the varieties now grown have scarcely any resemblance to the very small, woody, inferior fruit of the wild parent. As a country becomes more thickly settled, less and less reliance can be placed on wild fruits, and the market gardener and fruit grower become of increasing importance. In the United States, strawberries, blackberries and raspberries are examples of fruits which are still eaten both wild and cultivated, and cranberries have so recently come under cultivation that many persons still think of them as a wild fruit. Huckleberries and blueberries are practically unknown, except as they grow wild, though attempts are now being made to bring the blueberry to greater perfection under cultivation. Among little known wild fruits elderberries and scarlet haws or thorn apples, to give them their New England name, may be mentioned. Both are used for jelly making to some extent and the former for other purposes also, but as yet neither is considered as of much importance.

It would be difficult to say why some fruits which are considered to be fairly palatable and equal to others which are generally eaten have obtained so little popularity. For instance, both wild and cultivated mulberries have long been known and prized by many, but are perhaps unknown to the majority of persons and very little used. In the same way the medlar, a fruit closely related to the apple and common enough in parts of Europe, is almost unknown in the United States, though it could be readily grown, if desired.

In some of our cultivated fruits, like the banana, seed is almost never found; in the case of others, for instance the orange, the seedless and seed-bearing varieties are both common; but in the majority of fruits seeds are present in greater or less abundance. It has been said that seedlessness is a result of long continued cultivation, but it seems more probable that the seedless forms are due to the propagation and cultivation of natural sports without seeds. Seedless sports are by no means uncommon in wild fruits. Thus the native American persimmon is now and then found bearing seedless fruit, and such a form could be perpetuated by horticulturists, if need be. The seedless navel orange has been propagated in recent times from a seedless sport, and it seems very probable that bananas, though the wild forms are commonly full of seeds, were propagated from a seedless sport in times too remote for record. Indeed, it may be said that there is an almost universal tendency to cultivate and perpetuate varieties in which seeds are few in number or small in size, and quite naturally, since such fruits are more convenient to use and contain a higher proportion of nutritive material in a given bulk.

In general, it is true that size, yield, color, flavor, texture, and chemical composition are modified by cultivation.

The commercial fruit grower, of course, desires a fruit of good appearance, having satisfactory shipping and keeping qualities, and too often the consumer is satisfied to accept a product in which such qualities predominate. Discriminating purchasers, however, will insist on good flavor, texture and cooking qualities as well, and such demands should be more often urged in order that quality may replace appearance as a standard in cultivating fruit for market

Market Conditions and Fruit Supply

The fruit market has been very greatly modified and extended by improved methods of transportation and storage. A man need not be very old to remember the time when, at least in the Northern states, bananas were a comparative rarity outside the large cities, and oranges and lemons, though common commodities, were rather high in price. In the summer there was an abundance of the common garden fruits, but in winter apples were practically the only sort which was at all plentiful. A few years have witnessed a great change, and now there is hardly a village so small that bananas and other Southern fruits can not be purchased at reasonable prices. In Europe

the situation is much the same Such quantities of bananas are now taken to England and sold at such reasonable rates that they are sometimes spoken of there as the poor man's fruit. At the present time there are a number of fruits, such as avocados or "alligator pears," mangoes, and sapodillas, which are fairly well known in our large markets though seldom seen in the smaller towns. The enormous development of the fruit growing industry in California and Florida, which includes the products of both temperate and warm regions, as well as the possibilities of supplying the Northern markets with tropical fruits from Porto Rico and Hawaii, makes it probable that within a few years the avocado, the mango, and other tropical fruits will be as well known as the pomelo or the pineapple

Improvements in transportation have also materially lengthened the season of many fruits, such as strawberries, which can not be stored for any considerable period. Florida and the Carolinas now send their berries to Northern markets months before the home-grown crop can be expected and several weeks before that from tidewater Virginia or New Jersey is ripe As an illustration of the effect of improved methods in shipping fruit, it may be mentioned that melons from the south of France, hothouse peaches from Belgium, and peaches, plums and other fruits from South Africa are now sent to our American markets in winter. The introduction or origination of new varieties of fruits also prolongs the season. As an instance may be cited the Peen-to peach, a Chinese variety which can be successfully raised in Florida and Texas, and which is found in our Northern markets in early spring, though at present at prices which clearly make it a luxury. Furthermore, improved methods of culture and transportation have extended the area planted to old and well-known varieties.

Color and Flavor of Fruits

Fruits, like leaves and flowers, owe their varied color to a number of chemical compounds, the green to chlorophyll (the characteristic coloring matter of green leaves), the yellow to xanthin bodies and other yellow pigments, and the blue and red to solutions in the cell sap of complex coloring matters which have in most cases been isolated and classified. Several coloring matters are often present in combination and give rise to the great variety of shades which different fruits present. In white fruits coloring matter is absent from the epidermis and the cells are said to be filled with air. As fruits develop, mature, and deteriorate, the coloring matters present undergo marked chemical changes, and color is one of the most common means of judging of ripeness.

Attractive color has a decided effect on market value, and the public demand varies greatly in different regions. Thus, a yellow or russet dessert apple is demanded in the French market, while in many parts of the United States the red apple has the preference. A faded, dull color is often an indication of staleness; strawberries and raspberries which have been kept too long have little of the brilliant color of freshly gathered fruit. That fruit colors in general are not very permanent is shown by the way the color deteriorates on long-continued cooking or fades when canned and preserved fruits are exposed to the light.

In preparing such fruits as plums, peaches, etc., for the table, the skin may be readily removed without injury to the flavor by first immersing them for a short time in boiling hot water. A silver knife should always be used for paring apples, pears, and other fruits, as if a steel knife is used the acid of the fruit acts on the iron of the knife and frequently causes a black discoloration, and there is also very commonly a noticeable metallic flavor. If pared or cut fruit is exposed to the air, it rapidly turns dark in color, owing to the action of oxydases, as some of the ferments normally present in fruits are called, upon the tannin or other readily oxidizable bodies which are also normal fruit constituents.

In the same way the brown color of the bruised spots in apples is caused by oxid-

ation by means of the oxydases present in the fruit of the tannin in the crushed cells. Such bruised portions contain a larger proportion of starch than the rest of the apple because the tannin hinders the transformation of starch into sugar.

In investigations carried on at the Oregon Agricultural Experiment Station with a view to preventing the discoloration of evaporated fruits and vegetables, it was found that treating sliced apples with a weak solution of common salt (1 to 2 per cent) resulted in a product which was very bright and white and of better appearance than that obtained by the well-known domestic method of treatment with cold water. It seems probable that the Oregon method may find application in the household.

Fruits owe their flavor in considerable degree to the sugars and the malic, citric, and other acids which they contain, but the flavor which is so characteristic of different kinds is almost entirely due to ethereal bodies. The amount present is often too small for determination by the usual chemical methods. However, in many cases these flavor-giving bodies have been studied and their chemical nature is known.

The flavor of strawberries has been shown to be dependent in part at least upon the presence of a volatile oil with pronounced strawberry odor which is found in small proportions in the extracted fat of the dried berries. Recent German investigators* have identified the compound ethers which give bananas their characteristic flavor.

With the orange and other citrus fruits the oil found in the skin has a very characteristic odor and flavor which are always associated in our minds with the flavor of the fruit. Obviously, the small amount of these bodies of pronounced odor and flavor can not materially modify the nutritive value of fruits, but they are of great importance in considering the place of fruit in the diet, as they are very largely responsible for its attractiveness and palatability. There is no doubt that we all eat more readily the foods which please our palate than those which are of indifferent flavor, and there is every reason to believe that the foods which please are actually digested more easily than those which do not, since they stimulate a normal and abundant production of digestive juices.

* Deut Essigindus, 1905, p 81.

Composition of Fruits

Determining the proportion of water, protein, fat, carbohydrates (nitrogen-free extract and crude fiber), and ash in fruits as in other foods furnishes a convenient basis for pudging of their relative food value. It is quite common for chemists to determine, instead of their proximate constituents, the proportions of the different nitrogenous bodies present, as well as the amounts of the different sugars, etc., which in the ordinary method of analysis are grouped with the other carbohydrates.

The more detailed analyses are of great interest and value for many reasons, but with our present knowledge it seems fair to assume that the various sugars and starches, for instance, have the same nutritive value, and so a knowledge of the total quantity of these bodies present gives very satisfactory data for estimating the food value of the group.* Very many analyses and studies of fruit and fruit products have been made by chemists of the agricultural experiment stations, as well as by the different Bureaus of the Department of Agriculture. Table 1 summarizes a large amount of such data and shows the composition of fresh, dried, and preserved fruits and fruit products, and for comparison the composition of a few other foods as well. In this table and the discussions which follow, attention has been given especially to the fruit of northern and temperate regions and no attempt has been made to summarize the considerable amount of data available regarding tropical fruits, except some which are grown in the United States or which are fairly well known at least in the larger markets. Special studies of

* An extended summary of the more detailed analyses of fruits and fruit products may be found in Konig's Chemie der menschlichen Nahrungs und Genussmittel. Berlin, 1903, volume 1, fourth edition, pages 820-895.

tropical fruits have been made by the California and by the Maine experiment stations, and the Bureau of Chemistry† of this Department has reported an extended series of investigations of such fruits and the jams and preserves made from them.

Most of the fruits and fruit products included in the table are too well known to need description. Of those which are less familiar, the avocado or "alligator pear" is a green or purple fruit not unlike an egg plant in appearance. The portion eaten is the pulp which surrounds the single large seed. In texture it is soft and somewhat like butter, and to this quality it doubtless owes the name "midshipmen's butter," given to it in the days of sailing vessels. The avocado is eaten in a variety of ways, but is most commonly served as a salad. This fruit has a delicate, almost nut-like flavor, and is every year becoming more popular. Earlier publications‡ of this Department have discussed the avocado at length and described its cultivation and uses.

The fruits of several sorts of cactus are very commonly eaten in Mexico and other regions where cactus is abundant, and are common though less well known in New Mexico and the Southwest. Under the name of prickly pear or Indian fig fresh cactus fruits, particularly the oblong, oval, yellowish or reddish fruits of *Opuntia ficus indica*, showing here and there characteristic tufts of fine spines or bristles, are occasionally seen at certain seasons of the year in large fruit shops. Cactus fruits may be used for jam making and in similar ways. A rather hard solid preserve or "cactus cheese," which may sometimes contain nuts, is a Mexican sweetmeat.

Many varieties of the guava, a very aromatic tropical and sub-tropical fruit, are grown in the warmer regions of the United States, and its uses are so varied that it is often said the guava occupies much the same place in cookery in the Tropics as the apple in northern regions. The fresh fruit is seldom seen outside the regions where it is grown, but guava jelly and guava paste are common commercial products, and have been popular ever since the days when the West India merchantmen brought these delicacies, preserved tamarinds, and oranges and lemons to our northern markets as well as such staple goods as sugar and molasses.

The roselle or Jamaica sorrel is the fruit of a widely distributed tropical hibiscus which is grown extensively in California and Florida. The fruits somewhat resemble okra in form, are of a dark magenta color, and have an acid flavor much like that of cranberries. They are used for jams, jellies, etc.

The Surinam cherry is the fruit of a South American tropical shrub now grown to a limited extent in Southern Florida and California. It is about the size and shape of an ordinary cherry, and owes its common English name to this fact. The fruit is bright red in color, and has a sharp but pleasant acid flavor. The Surinam cherry is used for jelly making, etc., but is seldom a commercial product.

The loquat, commonly though incorrectly called the Japan plum, is grown to a considerable extent in the southern United States. The small, yellowish, plum-like fruits are almost translucent when ripe, and are covered with a downy fuzz or bloom. The pulp is soft and tender and quite tart until fully ripe. The flavor is distinct and agreeable. Loquats are used both raw and cooked, and both fresh and preserved fruits are commercial products.

The sapodilla, a tropical fruit which thrives in regions like the warmer parts of Florida, suggests a good-sized russet apple in appearance, but when broken open is quite different in character, as it contains a number of rather large flat brown seeds embodied in a tender brownish white pulp. The flavor is characteristic, and to some palates suggests a combination of a pleasant mild acid with caramel or brown sugar. The

† United States Department of Agriculture, Bureau of Chemistry Bulletin 87.

‡ United States Department of Agriculture, Bureau of Plant Industry Bulletin 77; Farmers' Bulletin 169.

sapodilla is a not uncommon commercial fruit in large fruit shops.

Perhaps no fruit of the Tropics is more often discussed than the mango, some persons being exceedingly fond of this juicy aromatic fruit while others are as outspoken in their dislike. There are countless varieties of the mango, and many of them have a rank turpentine-like flavor, and are very fibrous. These qualities are not apparent, however, in the best varieties, which are of very delicate flavor and very palatable. The fruit is cooked in a variety ot ways, being a staple article of diet in the Tropics, and is also eaten fresh. Some difficulty is experienced in shipping mangoes, as the flesh is very juicy and tender, but they are occasionally found in market at least as far north as Washington, D. C.

Table I

Average composition of fruit and fruit products.

Kind of Fruit	Refuse	Edible Portion						
		Water	Protein	Ether Extract	Carbohydrates: Nitrogen-free extract	Carbohydrates: Crude Fiber	Ash	Fuel value per pound
Fresh Fruits	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Calories
Apples	25.0	84.6	0.4	0.5	13.0	1.2	0.3	290
Apricots	6.0	85.0	1.1	....	13.4		.5	270
Avocado	29.0	81.1	1.0	10.2	6.8		.9	512
Bananas	35.0	75.3	1.3	.6	21.0	1.0	.8	460
Blackberries	....	86.3	1.3	1.0	8 4	2.5	.5	270
Cactus Fruit	....	79.2	1.4	1.3	11.7	3.7	2.7	375
Cherries	5.0	80 9	1.0	.8	16.5	.2	.6	365
Cranberries	....	88.9	.4	.6	8.4	1.5	.2	215
Currants	....	85.0	1.5	....	12.8		.7	265
Currants (black) *a*	....	79.0	*b*.5	*b*.3	13.1	*a*6.1	1.0	370
Figs	....	79.1	1.5	....	18.8		.6	380
Gooseberries *a*	....	85.6	*b*1.0	....	......	*c*13.1	.3	255
Grapes	25.0	77.4	1.3	1.6	14.9	4.3	.5	450
Guava *a*	....	82.9	1.3	.7	8.0	6.6	.5	315
Huckleberries	....	81.9	.6	.6	16.6		.3	345
Lemons	30.0	89.3	1.0	.7	7.4	1.1	.5	205
Loquat	....	77.9	.2	....	20.2	.6	1.1	395
Mango *a*	*b*40.0	87.4	.6	.4	9 9	1.2	.5	220
Medlar *a*	....	74.6	.5	.3	16.5	7.5	.6	455
Mulberry *a*	....	84.7	.4	......	14 3		.6	280
Muskmelons	50.0	89.5	.6	......	7 2	2.1	.6	185
Nectarines	6.6	82.9	.6	......	15.9		.6	305
Olives	17.9	67.0	2.5	17.1	5.7	3.3	4.4	407
Oranges	27.0	86.9	.8	.2	11 6		.5	240
Peaches	18.0	89.4	.7	.1	5 8	3.6	.4	190
Pears	10.0	80.9	1.0	.5	15.7	1.5	.4	163
Persimmons	*b*25.0	66.1	.8	.7	29.7	1.8	.9	630
Persimmons (Japanese)	24.0	80.2	1.4	.6	15 1	2.1	.6	174
Pineapples	40.0	89.3	.4	.3	9 3	.4	.3	200
Plums	5.0	78.4	1.0	....	20 1		.5	395
Pomegranates	*b*30.0	76.8	1.5	1 6	16.8	2.7	.6	460
Prunes	5.8	79.6	.9	....	18.9		.6	370
Raspberries (red)	....	85.8	1.0	......	9 7	2.9	.6	255
Raspberries (black)	....	84.1	1.7	1.0	12.6		.6	310
Red bilberry	....	89.6	.1	*b*.3	3.8	*b*6.0	.2	190
Rhubarb stalks	40.0	94.4	.6	.7	2.5	1.1	.7	105
Roselle calyx	....	86.5	2.1	.3	10.3		.8	235
Roselle pod	....	84.0	1.7	1.0	12.2		1.1	290
Sapodilla *a*	*b*40.0	77.9	.5	1.6	16.6	2.8	.6	425
Scarlet haws	20.0	75.8	2.0	.7	18.6	2.1	.8	212
Strawberries	5.0	90.4	1.0	.6	6.0	1.4	.6	180
Surinam cherry	....	85 0	.4	....	13.9		.7	260
Watermelons	59.4	92.4	.4	.2	6.7		.3	140
Whortleberries	....	82.4	.7	3.0	10.3	3.2	.4	390
Dried Fruits								
Apples	....	26.1	1.6	2 2	62.0	6 1	2.0	1,350
Apricots	....	29.4	4.7	1.0	62.5		2.4	1,290
Bananas *a*	....	29 2	5.3	2.3	55.8	2 1	5.3	1,240
Banana flour	....	9.7	3.1	.5	83 4	.7	2.6	1,610
Citrons	....	19 0	.5	1.5	78.1		.9	1,525
Dates	10 0	15 4	2.1	2.8	74 6	3.8	1.3	1,615
Figs	....	18.8	4 3	.3	68 0	6.2	2.4	1,475
Pears	....	16 5	2.8	5.4	66 0	6.9	2.4	1,635

a European analysis. *b* Assumed. *c* Including 3.5 per cent skin and seeds.

Table I—Continued

Kind of Fruit	Refuse	Edible Portion						
		Water	Protein	Ether Extract	Carbohydrates		Ash	Fuel value per pound
					Nitrogen-free extract	Crude Fiber		
Dried Fruits—Continued	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Calories
Prunes	15.0	22.3	2.1	....	71.2	2.1	2.3	1,400
Raisins	10.0	14.6	2.6	3.3	73.6	2.5	3.4	1,605
Raspberries	....	8.1	7.3	1.8	80.2		2.6	1,705
St. John's bread	....	b17.3	5.7	1.1	67.0	6.4	2.5	1,480
Zante currants (English currants)	....	17.2	2.4	1.7	71.2	3.0	4.5	1,495
Canned Fruits, Preserves, Jellies, Etc.								
Crab apples (canned)	....	42.4	.3	2.4	54.4		.5	1,120
Apple sauce	....	61.1	.2	.8	37.2		.7	730
Apricots (canned)	....	81.4	.9	....	17.3		.4	340
Apricot sauce	....	45.2	1.9	1.3	48.8		2.8	1,000
Blackberries (canned)	....	40.0	.8	2.1	56.4		.7	1,150
Blueberries (canned)	....	85.6	.6	.6	12.8		.4	275
Cherries (canned)	....	77.2	1.1	.1	21.1		.5	415
Cherry jelly	....	21.0	1.1	....	77.2		.7	1,455
Figs, stewed	....	56.5	1.2	0.3	40.9		1.1	785
Grape butter	....	36.7	1.2	.1	58.5		3.5	1,115
Olives, green, pickled	27.0	58.0	1.1	27.6	11.6		1.7	1,400
Olives, ripe, pickled	19.0	64.7	1.7	25.9	4.3		3.4	1,205
Orange marmalade	....	14.5	.6	.1	84.5		.3	1,585
Peaches (canned)	....	88.1	.7	.1	10.8		.3	220
Pears (canned)	....	81.1	.3	.3	18.0		.3	355
Pineapples canned)	....	61.8	.4	.7	36.4		.7	715
Prunes, stewed	....	76.6	.5	.1	22.3		.5	430
Strawberries, stewed	....	74.8	.7	....	24.0		.5	460
Angelica stalks (candied)	....	10.4	.1	.1	87.3	1.5	.6	1,550
Apricots (candied)	....	14.4	.7	.1	83.0	1.1	.7	1,445
Cherries (candied)	....	12.1	.5	.2	86.1	.5	.6	1,455
Citron (candied)	....	18.2	.1	.1	77.6	1.0	3.0	1,380
Ginger root (candied)	....	12.3	.3	.2	86.1	.7	.4	1,520
Fruit Products								
Olive oil	....	....	....	100.0	....	....	....	4,035
Raspberry juice	....	49.3	.5	....	a49.9	....	.3	935
Unfermented grape juice	....	92.2	.2	b.5	6.9	....	.2	150
Other Foods for Comparison								
Cabbage	15.0	91.5	1.6	.3	4.5	1.1	1.0	145
Potatoes	20.0	78.3	2.2	.1	18.0	.4	1.0	385
Wheat flour, high grade	....	12.0	11.4	1.0	74.8	.3	.5	1,650
Corn meal, bolted	....	12.5	9.2	1.9	74.4	1.0	1.0	1,655
White bread	....	35.3	9.2	1.3	52.6	.5	.5	1,215
Beans, dried	....	12.6	22.5	1.8	55.2	4.4	3.5	1,605
Honey	....	18.2	.4	....	81.2	....	.2	1,520
Sugar, granulated	....	....	....	....	100.0	....	....	1,860
Butter	....	11.0	1.0	85.0	....	....	3.0	3,605

a Probably contained added sugar. *b* European analysis.

Most fruits, like other classes of foods, contain more or less material, such as pits, skin, etc., which is inedible. When such portions are removed a larger or smaller part of the edible material is almost always of necessity removed also, and is spoken of as "waste." In reporting analyses the amounts of inedible material and waste are grouped together under the heading "refuse." As may be seen from the above table, the proportion of refuse in fruits varies within rather wide limits. Thus, of pears it constitutes on an average 10 per cent of the total fruit, peaches 18 per cent, apples and grapes 25 per cent, and bananas 35 per cent, while in the case of raspberries and blackberries there is no refuse and the whole fruit can be eaten.

The analytical data quoted above show that fresh fruits are in general dilute foods—that is, the proportion of water which they contain is large, compared with the total amount of nutritive material. It has been suggested that fruits containing 80 per cent or more of water be classed as flavor fruits and those with less than 80 per cent as food fruits. As

may be seen from Table I such fruits as strawberries, blackberries, and raspberries would be included in the first class, and fresh figs, bananas, grapes, etc., in the second. In dried fruits which have been concentrated by evaporation the percentage of nutrients is very much higher than in fresh fruits. Some preserved fruits also possess a comparatively high nutritive value, owing to the evaporation of water by the heat of cooking or to the addition of sugar, or to both factors. Candied fruits, such as cherries and apricots, which are included in the table, may be looked upon as typical examples of this class of fruit products. As regards composition, the water content is low and the carbohydrates and consequently the energy value is very high, owing to the added sugar.

Olives and the avocado are remarkable for the large percentage of fat which they contain, but in general it may be said that this constituent is present in very small proportion in fresh fruits. In the case of the apple, pear, etc., it seems probable that the small amount of fat obtained in chemical analysis consists of the coloring matter contained in the fruit or of wax found in the skin. That the amount of wax may be considerable is evident when we recall the fact that fruit wax is collected from bay berries and other fruits in quantities sufficient for candle making and other purposes. That common fruits actually contain fat, though it is not generally associated with them, is shown by a recently published study of the fat of woods strawberries. The dried berries when extracted yielded a small amount of oil, cloudy at ordinary temperatures, but clear when heated, and much like linseed oil in its properties.

In the majority of fruits and fruit products the carbohydrates are the food constituents most abundantly represented. The figures in the table show that the proportion of nitrogen-free extract varies greatly, being lowest in the fresh and highest in the dried and preserved fruits. It is interesting to consider also the values which have been reported for some of the constituents not shown in the table, but included in the group "nitrogen-free extract." In seeds which are commonly eaten, such as the cereal grains, and beans, peas, and other legumes, the nitrogen-free extract is quite largely made up of starches. In fruits, however, sugars and the so-called pectin bodies, with very often more or less starch, make up the group. The principal sugars in fruit are cane sugar, grape sugar (glucose), and fruit sugar (levulose), the last two being usually present together in equal quantity and designated invert sugar or reducing sugar. The stage of growth and the degree of ripeness have a very marked effect on the kind and amount of sugar, and it is therefore difficult to give average figures for the quantities present which will be fairly representative. An idea of the range in the sugar content of ripe fruits may be gathered from figures quoted from a summary* published several years ago. According to these data, invert sugar ranged from 2 per cent in round numbers in large early apricots to 15 per cent in grapes and a variety of sweet cherries. A number of fruits (strawberries, gooseberries, raspberries, and apples) contained about half the latter quantity. The cane sugar ranged from less than 1 per cent in lemons to 14 per cent in a variety of plums. Bananas also contained a fairly high percentage, namely, 11 per cent.

Fruit sugar rarely occurs unaccompanied by grape sugar, but has been thus reported in the mango and in amounts large in proportion to the grape sugar in sweet apples and sweet pears and a number of varieties of grapes. In the case of grape sugar large amounts—18 to 30 per cent—have been reported in juice of different sorts of grapes, while in dried fruits the values are even higher, 32 per cent having been found in prunes, 54 per cent in Zante or "English" currants, which are of course a small seedless grape, 61 per cent in raisins, 48 per cent in figs, and 66 per cent in dates.

* Lippman: Chemie der Zuckerarten, 1895, third edition, pages 493, 591; 1904, fourth edition, pages 200, 794.

The acid in fruits, which in proximate analyses is not usually determined separately, varies within rather wide limits, 1 to 2 per cent being reported on an average in such fruits as apples, pears, plums, strawberries, etc., and as high as 7 per cent or more in lemon juice. It often happens that of two fruits with the same acid content one has a much sourer taste than the other, because the acid is not so much masked by sugar.

Fruits contain a comparatively small amount of mineral matter—less than 1 per cent on an average—consisting quite largely of potassium salts, with a little phosphoric acid, iron, lime, etc.

As a class, it is apparent that fresh fruits are directly comparable with green vegetables and root crops rather than with more concentrated foods, such as flour or meal. The dried and some of the preserved fruits, which are more concentrated than the fresh, compare favorably with bread, dried beans, and similar foods on the basis of total food material present. There is this difference, however, that the cereals and dried legumes contain fairly large proportions of protein, while the quantity present in fruits is always small. In other words, fruits—fresh, dried, and preserved—are sources of energy rather than of tissue-forming material.

Grape juice and other freshly expressed juices are pleasant and wholesome beverages. They are commonly preserved for winter use at home as well as on a commercial scale by sterilizing in bottles. The fruit juices are dilute foods, as the figures given for grape juice in Table 1 indicate. Fruit syrups made by adding sugar to the juice are extensively used in the household and in other ways. The food value of such articles is, of course, considerably increased by the sugar which they contain.

In connection with the subject of fruit juices and syrups, it may be of interest to mention the Turkish preparation, which is made by evaporating grape juice until it is of the consistency of molasses, then thickening with flour or starch, and spreading it out to dry in the sun in thin sheets. This product is not unlike the peach leather, which is an old-fashioned domestic product still made to some extent in much the same way in the southern United States by drying crushed peach pulp on platters in an oven. Plum leather is also sometimes made in the same way After soaking in water for some hours peach leather is ready for use on the table or for making puddings, etc. Another Turkish preparation called sujuk or rojik is made by stringing walnuts on pieces of stout twine about a yard long and immersing them in a mixture of grape molasses and flour. After receiving a coating about one-fourth of an inch thick they are withdrawn and hung up to dry, and may then be preserved in jars in good condition for a few months. Sujuk is said to be an excellent article of food and palatable. Sometimes wheat grits are used to thicken the grape syrup, and the nut and syrup mixture is made in the form of cakes about one-half an inch thick when dried.

Vinegar, which contains about 3 per cent of extractive material and 0.5 per cent ash, in addition to 6 per cent acetic acid and over 90 per cent water, is one of the oldest fruit products and also one of the oldest and most common condiments and household preservatives. It owes its use in the diet to flavor and other qualities rather than to the very small amount of nutritive material which it may contain. Honey vinegar,* malt vinegar, etc., are well known, but vinegar made from fruit juice is far more common. By fermentation the sugar in the original material is converted into acetic acid, and to this the vinegar largely owes its flavor, though the salts and other materials originally present in the fruit juice have an effect upon this quality. Vinegar made from apple juice—that is, cider vinegar†—has always had a reputation for good quality, though other fruit juices are of considerable importance in domestic vinegar making, banana vine-

* For description and method of making, see United States Department of Agriculture, Farmers' Bulletin 276.

†Vinegar making and related questions are taken up in United States Department of Agriculture, Farmers' Bulletin 233.

gar being one of the sorts which is rather favorably known in regions where this fruit is grown. The acid juice of lemons and limes is used like vinegar as a condiment, and many persons consider that lemon juice is more delicate. It is sometimes claimed that it is more wholesome also, but this seems hardly more than a matter of opinion, as there is no reason to suppose that the small amounts of vinegar ordinarily used are in any way harmful.

Verjuice, the expressed acid juice of green apples, crab apples, or other unripe fruit, was formerly used as a condiment and was greatly prized. It has survived in modern cookery in a limited way and may occasionally serve a useful purpose when lemon juice is not readily obtainable.

Ripening and Its Effect on Composition

As fruits grow to their full size and ripen they undergo marked changes in chemical composition with respect both to the total and to the relative amount of the different chemical bodies present. When stored after gathering, the changes continue, some fruits improving on storage and others deteriorating very rapidly. In general, ripe fruits are less acid than green and contain less starch, woody material, crude fiber, and the carbohydrates commonly referred to as pectin bodies and correspondingly larger amounts of the different sugars.

Fruits contain oxydases and other ferments, and these are believed to play a very important part in the chemical changes which accompany growth and maturity. Many diverse views have been expressed regarding the exact nature and extent of the processes involved and the compounds formed in ripening fruit. The question as a whole has been a favorite one with chemists, and the agricultural experiment stations have made a number of important contributions to the subject. One of the most recent and valuable contributions, both from a bibliographical and from a chemical standpoint, is the series of investigations published by Bigelow * and his associates, of the Bureau of Chemistry of the Department of Agriculture, on the ripening of winter and summer apples and of peaches. With winter apples it was found that the starch increases from early summer until the maximum is reached in midsummer and then decreases and finally disappears. The malic acid content decreases from early summer until maturity, while cane sugar and invert sugar increases.

In the case of peaches, as the fruit develops from early summer to ripeness the proportion of flesh increases and the pit decreases. During this period the weight of reducing sugars increases about eight times and that of cane sugar or sucrose and acids considerably more than this. An increase is also noted with the various forms of nitrogenous substances. Throughout the whole period of growth the proportion of solids to water in the flesh of the peach remains fairly constant. The pit, on the other hand, becomes harder and the percentage of water in it decreases as growth progresses. It is interesting to note that throughout the whole period of growth no appreciable amount of starch is found in the peach. Between the condition known as market ripeness and full ripeness considerable growth takes place in the peach, there being an increase in both water and solid matter and in reducing sugar and cane sugar. A German investigator ‡ found that when black currants were picked when slightly green and kept for a few days there was an increase in sugar and a decrease in the acid content. The changes which take place in gooseberries do not appear to be of the same character. Picked when green, they contain 3.9 per cent sugar and 27.2 per cent acid. When stored at a cool temperature for six days they had taken on the dark color of ripe berries and contained somewhat smaller proportions of both sugar and acid.

A knowledge of the changes which accompany the growth, ripening, and stor-

* U. S. Department Agriculture, Bureau of Chemistry Bulletins No. 94 and No. 97

‡ Landw. Jahrb. Schweiz., 19 (1905), p. 600.

age of fruits is very important commercially as well as from the housekeeper's standpoint. For instance, in cider making it is desirable that the fruit should be used when the sugar content is high, as the quality of cider and vinegar is largely determined by the amount of sugar present. As every housewife knows, underripe fruit—that is, fruit which still contains the so-called pectin bodies rather than the sugars and other carbohydrates characteristic of fully ripened fruit—is the most satisfactory for jelly making. In the case of bananas the underripe fruit, rich in starch, is best for cooking, and the very ripe fruit, in which the starch has been changed into sugar, for use uncooked. It is not unlikely that failure to recognize this distinction is responsible for the digestive disturbance which many persons experience when bananas are eaten, as the raw, underripe, starchy fruits are generally conceded to be difficult of digestion. The underripe bananas, when dried, sliced, and ground, yield a flour or meal rich in starch, while the riper fruit with the higher sugar content, sliced and dried, is very sweet and not unlike figs in flavor and composition.

Ways of Serving Fruit

As regards the way in which they are served fruits range from the muskmelon, watermelon, and avocado, almost never cooked, to cranberries and the ordinary varieties of quince, which are not eaten raw. The methods of preparation are quite varied, including drying or evaporating, and baking, boiling, and stewing, while quantities of fruit are used in puddings, pies, and other dishes, and for the preparation of jams, jellies, and preserves. Fruit juices are used for beverages, and both fruits and the juices are very commonly prepared for the table by freezing fruit ices being considered as among the most appetizing desserts. Some fruits, notably the green and the ripe olive and less generally the lime, are prepared for the table by pickling in brine.

Even a casual examination of cookery books and the periodical literature devoted to such topics shows that the ways in which fruits and fruit products can be cooked and served are practically endless. The housewife who desires to vary her menu by the use of more fruit and fruit dishes can do so very readily by consulting such sources of information.

The temperature at which fresh fruits are eaten is largely a matter of fashion or individual taste. With the increased use of ice in our homes during recent years it has become a very common custom to serve fruits colder than was formerly the case. Cool or even cold fruits are very refreshing and many prefer them served thus. There are others, however, who maintain that overchilling lessens the delicate flavor and accentuates the acid taste. They insist that the fruits gathered in the cool of the day and stored in a cool but not a cold place are at their best. Still others find them sweetest and most palatable when brought from the garden warmed by the sun.

Place of Fruit in the Diet

In most families fruits are commonly thought of as a food accessory, and are prized for their pleasant flavor or for supposed hygienic reasons rather than for their food value; yet a study of available figures shows that they constitute a by no means unimportant part of the diet, since they supply, on the basis of recent statistics, 4.4 per cent of the total food and 3.7 per cent of the total carbohydrates of the average American diet. With a view to learning something more definite regarding the possibilities of fruits as sources of nutrients, the relative cost of nutrients supplied by fruits and other foods, the digestibility of a fruit diet as compared with an ordinary mixed diet, and related questions, extended investigations were undertaken at the California Agricultural Experiment Station by Prof. M. E. Jaffa, the work as a whole being carried on in co-operation with the nutrition investigations of the Office of Experiment Stations. In the first series reported six dietary studies were made with fruitarians—two women and four children who had lived on a fruit and nut diet for several years. The dietary studies covered from 20 to 28

days, and the daily food consisted of different combinations of fruits and nuts, of which the following day's ration may serve as a sample: 475 grams apples, 110 grams bananas, 850 grams oranges, 5 grams dates, 2 grams honey, 10 grams olive oil, 55 grams almonds, 70 grams pine nuts, and 50 grams walnuts.

The later studies were made with one of the women and two of the children included in the first group, and in addition with two elderly men who had been vegetarians for years and had limited their diet almost exclusively to fruits and nuts, and with two young men, university students, who were accustomed to the ordinary diet, though one of them had experimented with a vegetarian and fruitarian diet for some time. The students and one of the elderly men ate three meals a day at the usual hours. The others ate but twice, the first meal being taken between 10 and 11 o'clock in the morning and the second between 5 and 6 o'clock in the afternoon. As before, the diet included a large assortment of fresh fruits, with considerable quantities of dried fruits and nuts, and some honey and olive oil. In a few cases small quantities of other foods were also eaten.

Considering these studies as a whole, the diet of the women and children furnished from 32 to 43 grams of protein and 1,190 to 1,430 calories of energy per day, the cost ranging from 15.7 to 27 5 cents. It is the usual custom to discuss dietary studies on the basis of the amounts eaten per man per day, and the results obtained with these women and children, when recalculated to this basis, showed a range of 47 to 80 grams of protein and 1,850 to 2,805 calories of energy, the cost of the daily food ranging from 21 to 55 cents per man per day. In the studies with the young and the old men the protein supplied by the daily diet ranged from 40 to 85 grams and the energy from 1,712 to 3,305 calories, the average being 62 grams protein and 2,493 calories, the cost ranging from 18.1 to 47 cents per person per day. These amounts are considerably smaller than have been found on an average with families living in many different regions of the United States and under a variety of conditions, as is shown by the fact that with 52 families in comfortable circumstances the average protein in the daily diet was 103 grams and the average energy 3,500 calories. On the other hand, in many of the dietary studies made under the auspices of the Office of Experiment Stations it has been found that persons living on a mixed diet have obtained amounts directly comparable with those supplied by the fruitarian diet. Thus, at the North Dakota Agricultural College several years ago a dietary study showed that the food consumed per man per day by a group of students furnished 64 grams protein and 2,579 calories and at Lake Erie College 68 grams protein and 2,610 calories, calculated on a uniform basis per man per day.

In a recent investigation carried on at Harvard it was found that the diet of nine students who lived at the college commons and, from necessity or choice, endeavored to live cheaply supplied, on an average, 89 grams protein and 3,068 calories. In this case the average cost was 39.9 cents per day and at the North Dakota and the Lake Erie colleges 13 and 18 cents, respectively. It will thus be seen that in the California investigations the fruit and nut diet supplied the subjects with amounts of protein and energy which are directly comparable with those obtained by many other persons from a mixed diet, though in general the quantities were smaller than are supplied by the diet of the average family. It should be said that the persons living on a fruit and nut diet apparently maintained their normal health and strength.

It seems fair to say that at the present time the consensus of opinion of well-informed physiologists is that the ordinary mixed diet is most convenient and satisfactory for the average individual. It is equally clear from the investigations reported that fruits and nuts should not be looked upon simply as food accessories, but should be considered a fairly economical source of nutritive material. It must be remembered, too, that the use of fruits, fresh and preserved, often makes palatable an otherwise rather tasteless meal. Jam with our bread is a reasonable com-

bination, the highly flavored fruit product whetting the appetite for the needed quantity of rather flavorless bread.

Digestibility of Fruit

In addition to the dietary studies, a large number of digestion experiments were made at the California Experiment Station for the purpose of learning how thoroughly a diet made up of various combinations of fruits and nuts was assimilated. In such an experiment covering ten days, made with a child seven years old, on an average 82 per cent of the protein, 87 per cent of the fat, 96 per cent of the nitrogen-free extract (sugar, starches, etc.), 80 per cent of the crude fiber, and 54 per cent of the ash of the food eaten were digested, and 87 per cent of the energy of the diet was available to the body. In 30 experiments with men, 75 per cent of the protein, 86 per cent of the fat, 95 per cent of the nitrogen-free extract, 79 per cent of the crude fiber, and 55 per cent of the ash of the fruit and nut diet were digested, and 86 per cent of the energy was available. These values are comparable with those obtained from an ordinary mixed diet, as is shown by the fact that in 93 experiments with young men 93 per cent of the protein, 95 per cent of the fat, and 98 per cent of the total carbohydrates supplied were assimilated. The average coefficients of digestibility which have been calculated for fruits in connection with the nutrition investigations carried on under the auspices of the Office of Experiment Stations are protein 85 per cent, fat 90 per cent, and carbohydrates 90 per cent, and those for fresh vegetables, protein 83 per cent, fat 90 per cent, and carbohydrates 95 per cent.

The feces excreted per person per day on the fruit and nut diet in the California experiments were less in amount than has been the case in some experiments with a mixed diet or a ration of bread and milk. This is contrary to what has been commonly found with a vegetarian diet made up of bread and other cereal foods, garden vegetables, etc., and containing little if any fruit or nuts. The percentage of so-called metabolic nitrogen in the feces from the fruit and nut diet did not exceed that reported by other investigators in tests with a bread and milk diet. In other words, if the amount of metabolic products can be looked upon as a measure of the work of digestion, no more effort is required to digest the fruit and nuts than is needed for bread and milk. Although, as Professor Jaffa points out, it is undoubtedly advisable to wait until more data have been obtained before making definite statements regarding the digestibility of fruits and nuts, enough has been done to show that they are almost completely digested and have a higher nutritive value than is popularly attributed to them. In view of this it is certainly an error to regard fruit as something of value only for its pleasant flavor or for its hygienic or medicinal properties, or to consider nuts simply as an accessory to an already hearty meal. As shown by the composition and digestibility of both fruit and nuts, they can be favorably compared with other and more common food.

So far as can be learned, comparatively few investigations have been made to ascertain the digestibility of particular fruits, raw or cooked. In a series of investigations by Bryant and Milner the digestibility of apple sauce was determined when eaten with a simple basal ration. The coefficients of digestibility for apple sauce alone were calculated in the usual way and were, protein 28 per cent, nitrogen-free extract 99.6 per cent, crude fiber 96 per cent, and ash 100 per cent, while all the energy supplied by the apple sauce was considered to be available to the body. The coefficient of digestibility of protein is low, but, as the authors pointed out, the total amount of this constituent present was so small that it may be disregarded. This investigation, like those at the California Experiment Station, indicates that the fruit carbohydrates (sugar, starches, etc.), that is, the principal nutritive materials which fruits supply, are very thoroughly assimilated.

Few studies seem to have been made to determine the ease or rapidity of digestion of different fruits in the stomach, but a comparison of available data indicates that fruits compare favorably with other

common foods as regards stomach digestion. Apparently it is fair to say that stomach digestion is influenced by the nature of the fruit and its stage of ripeness. Beaumont states that mellow sour apples eaten uncooked require two hours for digestion in the stomach and mellow sweet apples 1.5 hours. Another observer notes that about five ounces of raw ripe apple requires three hours and ten minutes for digestion in the stomach, but states that if the fruit is unripe, and consequently contains a high proportion of cellulose, a much longer time may be required.

Little is definitely known regarding the relative digestion and absorption of fruits in the intestine, but experiments indicate that as a class ripe fruits are quite thoroughly digested, and it is evident that, generally speaking, fruits, like other foods, usually remain in the intestinal tract long enough for the body to absorb the nutritive material present, and that therefore the rate of intestinal digestion would not be a matter of special importance.

Relative Economy of Fruits and Other Foods

In connection with his studies of the comparative value of fruits, Professor Jaffa summarizes data regarding the cost of nutrients and energy supplied by fruits as compared with some other foods at certain values per pound. Some of his data follow:

Table No. 2—Comparative Cost of Total Nutrients and Energy in Fruits and Other Food Materials at Certain Average Prices

Kind of Food Material	Price per pound	Cost of 1 pound protein	Cost of 1,000 calories energy	Amounts for 10 cents				
				Total weight of food materials	Protein	Fat	Carbohydrates	Energy
Fresh Fruits	Cents	Dolls.	Cents	Lbs.	Lbs.	Lbs.	Lbs.	Calories
Apples	1.5	5.00	7.3	6.67	0 02	0.02	0.72	1,467
Bananas	7.0	8.75	23.3	1.43	.01	....	.21	429
Grapes	4.0	4.00	11.9	2.50	.03	.03	.36	837
Oranges	6.0	10.00	35.2	1.67	.01	....	.14	284
Peaches	4.0	8.00	25.1	2.50	.01	....	.19	398
Pears	3.0	6.00	11.5	3.33	.02	.01	.42	866
Plums	3.0	3.33	8.1	3.33	.03	....	.64	1,232
Watermelons	1.5	7.50	25.0	6.67	.01	....	.18	400
Blackberries	7.0	5.38	25.9	1.43	.02	.01	.16	386
Cranberries	5.0	·12.50	23.3	2.00	.01	.01	.20	430
Currants	5.0	3.33	18.9	2.00	.03	....	.26	530
Raspberries	7.0	7.00	27.4	1.43	.01	....	.18	365
Strawberries	7.0	7.78	40.0	1.43	.01	.01	.10	250
Dried Fruits								
Apples	12.0	7.50	8.9	.83	.01	.02	.55	1,121
Dates	10.0	5.26	6.9	1.00	.02	.03	.71	1,450
Figs	15.0	3.50	10.2	.67	.03	....	.50	988
Prunes	10.0	5.56	8.4	1.00	.02	....	.62	1,190
Raisins	10.0	4.35	6.9	1.00	.02	.03	.69	1,445
Jams, Preserves, Etc.								
Apple preserves	16.0	91.43	13.8	.62	....	....	.39	727
Apple butter	5.0	10.00	5.6	2.00	.01	....	.94	1,780
Currant and raspberry jam	16.0	26.66	12.8	.62	....	....	.42	781
Gooseberry jam	16.0	32.00	13.2	.62	....	....	.40	752
Orange marmalade	16.0	26.66	10.1	.62	....	....	.52	983
Prune sauce	16.0	32.00	37.2	.62	....	....	.14	267
Strawberry preserves	16.0	26.67	12.0	.62	....	....	.44	833
Apple jelly	16.0	53.33	12.2	.62	....	....	.43	812
Currant jelly	16.0	40.00	13.4	.62	....	....	.40	744
Guava jelly	16.0	53.33	10.5	.62	....	....	.51	952
Quince jelly	16.0	80.00	13.3	.62	....	....	.40	750
Apricots, canned	16.0	17.78	47.1	.62	.01	....	.11	211
Pears, canned	16.0	53.33	45.5	.62	....	....	.11	220
Peaches, canned	16.0	20.00	53.2	.62	....	....	.09	188
Grape juice	20.0	83.33	128.2	.50	....	....	.04	78
Other Foods for Comparison								
Porterhouse steak	25.0	1.31	22.5	.40	.07	.07	....	444
Leg mutton, hind	20.0	1.30	22.2	.50	.07	.07	....	445
Whole milk	3.5	1.06	10.5	2.86	.09	.11	.14	925
Skim milk	2.0	.59	11.8	5.00	.17	.02	.26	850
Wheat flour, patent roller process, high grade and medium	2.5	.22	1.5	4.00	.46	.04	3.00	6,600
White bread	5.0	.54	4.2	2.00	.18	.03	1.06	2,430
Rye bread	5.0	.56	4 3	2.00	.18	.01	1.06	2,360
Sugar	6.0	....	3 2	1.67	....	....	1.67	3,106
Candy	20.0	....	11.2	.50	....	....	.48	892
Beans, dried	5.0	.22	3.1	2.00	.45	.03	1.19	3,210
Celery	5 0	5 56	71 4	2.00	.02	......	.05	140
Potatoes, 90 cents per bushel	1 5	83	4 8	6 67	.12	01	98	2,068

From the data in the foregoing table it appears that fruits are comparatively expensive sources of protein as compared with flour or dried legumes, the fruit juices being the most expensive and the dried fruits the cheapest of the fruit products Ten cents on an average will purchase fully as much energy when spent for fresh fruits and more when spent for dried fruits than for lean meats, but much less than when expended for wheat flour. From the data as a whole it is apparent that fruits are reasonably cheap sources of energy in the diet and are well suited on grounds of economy for combination in reasonable quantity with cheap proteid foods to furnish a well-balanced ration.

Cooking and Its Effects on Fruit—Jelly Making

As is the case with all vegetable foods, the heat of cooking breaks down the carbohydrate walls of the cells which make up the fruit flesh, either because the moisture or other cell contents expands and ruptures the walls or because the cell wall is itself softened or dissolved. Texture, appearance, and flavor of fruit are materially modified by cooking, and if thorough it insures sterilization, as in the case of all other foods. The change in texture often has a practical advantage, since it implies the softening of the fruit flesh so that it is more palatable and may be more readily acted upon by the digestive juices. This is obviously of more importance with the fruits like the quince, which is so hard that it is unpalatable raw, than it is with soft fruits like strawberries. When fruits are cooked without the addition of water or other material, as is often the case in baking apples, there is a loss of weight, owing to the evaporation of water, and the juice as it runs out carries some carbohydrates and other soluble constituents with it, but under ordinary household conditions this does not imply waste, as the juice which cooks out from fruit is usually eaten as well as the pulp Cooking in water extracts some of the nutritive material present. Thus, a German investigator found that after boiling, apples and pears contained four or five per cent and peaches about seven per cent less carbohydrates than the uncooked fruit. In this case also such removal of nutritive material is of no practical importance

The idea is quite generally held that cooking fruit changes its acid content, acid being sometimes increased and sometimes decreased by the cooking process. Kelhofer* showed that when gooseberries were cooked with sugar the acid content was not materially changed, these results being in accord with his conclusions reached in earlier studies with other fruits. The sweeter taste of the cooked product he believed to be simply due to the fact that sugar masks the flavor of the acid.

It is often noted that cooked fruits, such as plums, seem much sourer than the raw fruit, and it has been suggested that either the acid was increased or the sugar was decreased by the cooking process. This problem was studied by Sutherst,‡ and in his opinion the increased acid flavor is due to the fact that cooked fruit (gooseberries, currants, plums, etc) usually contains the skin, which is commonly rejected if the fruit is eaten raw. The skin is more acid than the pulp, as was shown by analyses of gooseberries, in which the skin was found to contain 2.7 per cent acid and the pulp 1.8 per cent To determine whether acid is formed when fruit is cooked, Sutherst boiled a mixture of nearly ripe gooseberries in water for about thirty minutes and then measured the amount of acid by trituration with sodium hydroxid solution. The boiled portion was found to contain less acid than the raw, probably because some of the acid was volatile and passed off with the steam.

As regards the effect of cooking on the kind and amount of sugar present, uncooked gooseberries were found to contain 1.2 per cent cane sugar and 5.8 per cent invert sugar. After boiling, no cane sugar was found, while the invert sugar amounted to 6.9 per cent. This

* Landw. Jahrb. Schweiz, 19 (1905), pp 601, 602

‡ Chemistry News, 92 (1905), No 2393, p 163.

indicates that all the sugar undergoes inversion during cooking, the acid present bringing about the inversion in the usual way.

When fruits or fruit juices are cooked with sugar, the material very commonly solidifies or jellies on cooling, and this well-known property is taken advantage of in jelly making. In the case of some fruits, like the apple, the jelly-yielding material must be extracted from the fruit by cooking with hot water, while in the case of other fruits—the currant, for instance—this extraction with hot water is not necessary, as the expressed juice will produce a jelly. Heating the extracted or expressed juice is commonly considered a necessary step in jelly making, but some fruit juices will, on standing, jelly without heat, and laboratory tests have shown that jelly may also be obtained without the addition of sugar. Cooking and the addition of sugar are, however, important features in the practical consideration of jelly making, as they have a decided effect upon the yield, flavor, and keeping qualities of the resulting product.

Some fruits, like the ordinary varieties of pear, possess so little of the jelly-yielding material or possess it in such an unusual form that they do not yield a good jelly under ordinary household methods of treatment. The proportion of jelly-yielding material, like other constituents, varies with the stage of maturity, underripe rather than overripe fruit being best for the purpose.

The jelly-yielding bodies are known to be carbohydrates and have been called pectin, pectose, pectin bodies, or some similar name. They have been commonly grouped with the plant gums and similar carbohydrates, and the true nature of these materials has been the subject of a great deal of study.* At the present time the consensus of opinion seems to be that the pectins are composed of several of the simpler carbohydrates united to form a complex carbohydrate. In some fruits, like the apple, where the jelly-yielding material must be extracted with hot water, the pectin is apparently united with cellulose as a part of the solid pulp As shown by the investigations of Bigelow and Gore at the Bureau of Chemistry, 40 per cent of the solid material of apple pulp may be thus extracted with hot water, and consists of two carbohydrates, one of which is closely related to gum arabic. That such carbohydrates as these should yield a jelly is not surprising when we remember that they are similar to starch in their chemical nature, and, as every one knows, starch, though insoluble in cold water, yields when cooked with hot water a large proportion of paste which jellies on cooling.

When fruits are used for making pies, puddings, etc, the nutritive value of the dish is, of course, increased by the addition of flour, sugar, etc, and the dish as a whole may constitute a better balanced food than the fruit alone. It is commonly believed that dishes in which fruits are cooked with the addition of sugar, butter, and a flour crust of some sort are less easily digested than simple rations of bread, butter, and fruit having an equivalent nutritive value. The large number of digestion experiments which have been made with various mixed diets do not indicate that there is any special difference between the two rations as regards thoroughness of digestion, but additional experiments must be undertaken before it can be said with certainty whether or not there are actual dfferences in the ease and rapidity of digestion.

In different countries opinions vary markedly regarding the relative wholesomeness of raw and cooked fruit. Thus, as has often been pointed out, the Germans use comparatively little raw fruit and consider it far less wholesome than cooked fruit. On the other hand, in the United States raw fruit of good quality is considered extremely wholesome, and

* The Bureau of Chemistry of the Department of Agriculture has reported a number of important studies on the jelly-yielding constituents of fruit and an extended summary of previous investigations of the chemical nature of pectins and related questions. U. S. Dept Agriculture, Bureau of Chemistry Bulletin No 94; Journal American Chemistry Society, 28 (1906), p. 200.

is used in very large quantities, being as much relished as cooked fruit, if indeed it is not preferred to it. It has been suggested that the European prejudice against raw fruit may be an unconscious protest against insanitary methods of marketing or handling and the recognition of cooking as a practical method of preventing the spread of disease by fruit accidentally soiled with fertilizers in the fields or with street dust.

Overripe, Decayed and Unripe Fruit

Overripe fruit is often injurious, very probably because it has begun to ferment, and stale or partially decayed fruit is obviously undesirable for food purposes. In addition to a deterioration in flavor there is always the possibility of digestive disturbance if such fruit is eaten raw. Of course, where apples are raised or where they are bought in large quantities for family use the thrifty housewife will sort them over and use for cooking the sound portions of those which have begun to decay. In such cases, however, the best available methods of storing should be followed and sorting should be done at frequent intervals, for if decay has proceeded very far the flavor is without doubt injured.

If fruits could be kept unbruised and with the skin unbroken, decay would be much delayed, as the mold spores, rots, etc., which cause decay, find their readiest entrance through broken skins. That mechanical injuries are the principal causes of decay was shown in a study of citrus fruits. When the skin of an orange or lemon is broken the blue mold finds access to the wound, and under favorable conditions of moisture and temperature develops readily and causes decay. An examination of hundreds of boxes of California oranges showed that a large percentage of all the fruit was made susceptible to such decay by accidental injuries to the skin in packing.

It is not at all strange that decayed fruit should have a decided characteristic odor and flavor when we remember that the decay is very commonly caused by fungi, especially molds and rots, which penetrate the pulp and grow and develop rapidly. The fungi live upon the cell contents, particularly sugars and proteids, and produce bodies of marked chemical characteristics, including odor and flavor. It is said that the most unpleasant effects are due to one of the common molds.

It is almost universally believed that green fruit is unwholesome and causes serious digestive disturbances, yet those who have been brought up in the country know that if illness had always followed eating it there would have been few well children in the community in the summer. Recognizing that green fruit may be a cause of illness at times and at other times apparently harmless, two German scientists have recently carried on extensive studies to ascertain the truth of the matter. Chemical analyses were made of fruits of varying degrees of ripeness, and studies in which green fruit was eaten in considerable quantities and under varying conditions were carried on with both animals and men. It appears from the results of the experiments that although unripe fruit is undoubtedly often harmful, particularly for children, the danger from such foods, especially green gooseberries, plums, pears and apples, when eaten raw, is less than is commonly thought, and the effects depend in marked degree upon individual peculiarities.

The green fruit was found to contain the same chemical compounds as the ripe fruit, though in different proportions—that is, no chemical element was found in the green fruit which was foreign to the ripe fruit and which could be considered in itself a cause for illness. The injurious effects of raw unripe fruit therefore, it appears, do not depend upon chemical constituents, but rather on the unusual proportions in which the constituents occur, and especially the large percentage of hard cell tissue, which, if imperfectly masticated, it will readily be seen, might be a source of digestive derangement. Possibly the excess of acid in the green fruit is also a cause of digestive disturbance. Cooked green fruit was found to be practically harmless, be-

ing especially palatable and wholesome when cooked with sugar.

The possibility of injury by bacterial contamination was considered, though the data available were not sufficient for final deductions. It is now well known that such diseases are usually caused by micro-organisms, so possibly the green fruit very frequently picked up beneath the tree is only an accidental carrier of the real cause of the digestive disturbances which may follow eating it.

AREA DEVOTED TO FRUIT IN GREAT BRITAIN

The area devoted to fruit production was reduced in 1910 by an amount equal to that gained in the previous year, reverting accordingly to the position in 1908.

The following table gives the area of each kind of fruit for the four years during which the particulars have been shown separately in the returns:

	1910	1909	1908	1907
Small Fruit:	Acres	Acres	Acres	Acres
Strawberries	27,451	30,064	28,815	27,827
Raspberries	8,840	9,257	9,323	8,878
Currants and Gooseberries	25,530	26,106	26,241	25,590
Other kinds (including mixed areas)	22,488	21,689	20,501	19,880
Total	84,309	87,116	84,880	82,175
Orchards:				
Apples	172,031	173,168	172,751	172,643
Pears	9,636	9,475	9,604	8,911
Cherries	11,597	11,474	11,868	12,027
Plums	16,397	16,777	15,683	14.901
Other kinds (including mixed areas)	41,012	40,442	40,391	41,694
Total	250,673	251,336	250,297	250,176

Report by R. H. Rew to the Secretary of the Board of Agriculture and Fisheries, Great Britain.

FRUIT GROWERS' UNIONS AND ASSOCIATIONS IN NORTHWEST

British Columbia

Armstrong Fruit Growers' Association, Armstrong.
Boswell-Kootenay Lake Union, Boswell.
British Columbia Fruit Growers' Association, Victoria.
Creston Fruit and Produce Exchange, Creston.
Grand Forks Fruit Growers' Association, Grand Forks.
Hammond Fruit Association, Ltd., Hammond.
Hatzic Fruit Growers' Association, Hatzic.
Kaslo Horticultural Association, Kaslo.
Kelowna Farmers' Exchange, Ltd., Kelowna.
Kootenay Fruit Growers' Union, Ltd., Nelson.
Mission Fruit Growers' Association, Mission.
Okanogan Fruit Union, Ltd., Vernon.
Queens Bay Fruit Growers' Association, Queens Bay.
Salmon Arm Farmers' Exchange, Salmon Arm.
Summerland Fruit Growers' Association, Summerland.
Victoria Fruit Growers' Exchange, Victoria.
Western Fruit Growers' Association, Mission.

California

California Farmers' Union, Fresno.
California Fruit Exchange, Sacramento.
California Fruit Growers' Exchange, Los Angeles.
Fresno Fruit Growers' Company, Fresno.
Lincoln Fruit Growers' Association, Lincoln.
Lodi Fruit Growers' Union, Lodi
Loomis Fruit Growers' Association, Loomis.
Newcastle Fruit Growers' Association, Newcastle.
Penryn Fruit Growers' Association, Penryn.
Sebastopol Apple Growers' Union, Sebastopol.
Sebastopol Berry Growers' Union, Sebastopol.
Stanislaus Farmers' Union, Modesto.
The Supply Company of the California Fruit Growers' Association, Los Angeles.
Turlock Fruit Growers' Association, Turlock.
Vacaville Fruit Growers' Association, Vacaville.
Winters Fruit Growers' Association, Winters.

Colorado

Boulder County Fruit Growers' Association, Boulder.
Capital Hill Melon Growers' Association, Rocky Ford.
Crawford Fruit Growers' Association, Crawford.
Delta County Fruit Growers' Association, Delta.
Denver Fruit and Vegetable Association, Denver.
Fair Mount Melon Growers' Association, Swink.
Fowler Melon Growers' Association, Fowler.
Fremont County Fruit Growers' Association, Canon City.
Granada Melon Growers' Association, Granada.
Grand Junction Fruit Growers' Association, Clifton, Palisade, Grand Junction.
Kouns Party Cantaloup Growers' Association, Rocky Ford.
Lamar Melon Growers' Association, Lamar.
Longmont Produce Exchange, Longmont
Loveland Fruit Growers' Association, Loveland.
Manzanola Fruit Association, Manzanola.
Manzanola Orchard Association, Manzanola.
Montrose Fruit and Produce Association, Montrose
Newdale Melon Growers' Association, Swink.

Colorado—Continued

Palisade Fruit Growers' Association, Palisade.
Paonia Fruit Exchange, Paonia.
Pent County Melon Growers' Association, Las Animas.
Produce Association, Debeque.
Rifle Fruit and Produce Association, Rifle.
Roaring Fork Potato Growers' Association, Carbondale.
Rocky Ford Melon Growers' Association, Rocky Ford.
San Juan Fruit and Produce Growers' Association, Durango.
The Producers' Association, Debeque.
Western Slope Fruit Growers' Association, Palisade

Idaho

Boise Valley Fruit Growers' Association, Boise.
Caldwell Fruit Growers' Association, Caldwell.
Council Valley Fruit Growers' Association, Council.
Emmett Fruit Growers' Association, Emmett.
Fruit Growers' Association, Moscow.
Lewiston Orchards Assembly, Lewiston.
Lewiston Orchards Association, Lewiston.
Nampa Fruit Growers' Association, Nampa
New Plymouth Fruit Growers' Association, New Plymouth.
Parma-Roswell Fruit Growers' Association, Parma
Payette Valley Apple Growers' Union, Payette.
Southern Idaho Fruit Shippers' Association, Boise.
Twin Falls Fruit Growers' Association, Twin Falls.
Weiser Fruit and Produce Growers' Association, Weiser.
Weiser River Fruit Growers' Association, Weiser.

Montana

Bitter Root Fruit Growers' Association, Hamilton.
Missoula Fruit and Produce Association, Missoula.
Woodside Fruit Growers' Association, Woodside.

New Mexico

San Juan Fruit and Produce Association, Farmington.

Oregon

Albany Fruit Growers' Union, Albany.
Ashland Fruit and Produce Association, Ashland.
Benton County Fruit Growers' Association, Corvallis.
Brownsville Fruit and Produce Association, Brownsville.
Coos Bay Fruit Growers' Association, Marshfield
Coquille Valley Fruit Growers' Union, Myrtle Point.
Cove Fruit Growers' Association, Cove.
Dallas Fruit Growers' Association, Dallas.
Douglas County Fruit Growers' Association, Roseburg.
Dufur Valley Fruit Growers' Union, Dufur.
Dundee Fruit Growers' Association, Dundee.
Estacada Fruit Growers' Association, Estacada.
Eugene Fruit Growers' Association, Eugene.
Hood River Apple Growers' Union, Hood River.
Hyland Fruit Growers of Yamhill County, Sheridan.
Imbler Fruit Growers' Union, Imbler.
La Grande Fruit Association, La Grande.
Lincoln County Fruit Growers' Union, Toledo.
McMinnville Fruit Growers' Association, McMinnville.
Milton Fruit Growers' Union, Milton.
Mosier Fruit Growers' Association, Mosier.
Mount Hood Fruit Growers' Association, Sandy.
Newburg Apple Growers' Association, Newburg.
Northwestern Fruit Exchange, 418 Spalding Building, Portland.
Northeast Gaston Farmers' Association, Forest Grove.
Oregon City Fruit and Produce Association, Oregon City
Rogue River Fruit and Produce Association, Medford
Salem Fruit Union, Salem.
Santiam Fruit Growers' Association, Lebanon.
Springbrook Fruit Growers' Union, Springbrook.
Stanfield Fruit Growers' Association, Stanfield.
Sutherlin Fruit Growers' Association, Sutherlin.
The Dalles Fruit Growers' Union, The Dalles.
Umpqua Valley Fruit Growers' Association, Roseburg.
Washington County Fruit Growers' Association, Hillsboro.
Willamette Valley Prune Association, Salem.

Utah

Bear River Valley Fruit Growers' Association, Bear River City.
Brigham City Fruit Growers' Association, Brigham City.
Cache Valley Fruit Growers' Association, Wellsville.
Centerville Fruit Growers' Association, Centerville.
Excelsior Fruit and Produce Association, Clearfield (post office Layton R. F. D.)
Farmers & Fruit Growers' Forwarding Association, Centerville
Green River Fruit Growers' Association, Green River.
Ogden Fruit Growers' Association, Ogden.
Springville Fruit Growers' Association, Springville.
Utah County Fruit and Produce Association, Provo.
Willard Fruit Growers' Association, Willard.

Washington

Apple Growers' Union of White Salmon, Underwood.
Bay Island Fruit Growers' Association, Tacoma
Brewster Fruit Growers' Union, Brewster.
Buckley Fruit Growers' Association, Buckley.
Cashmere Fruit Growers' Union, Cashmere.
Clarkston Fruit Growers' Association, Clarkston.
Cowlitz Fruit and Produce Association, Kelso.
Dryden Fruit Growers' Union, Dryden.
Elma Fruit and Produce Association, Elma.
Felida Prune Growers' Association, Vancouver.
Garfield Fruit Growers' Union, Garfield.
Goldendale Fruit and Produce Association, Goldendale.
Grandview Fruit Growers' Association, Grandview.
Granger Fruit Growers' Association, Granger.
Kalama Fruit Growers' Association, Kalama.
Kennewick Fruit Growers' Association, Kennewick.
Kiona Fruit Growers' Union, Kiona.
Lake Chelan Fruit Growers' Association, Chelan.
Lewis County Fruit Growers' Association, Centralia.
Lewis River Fruit Growers' Union, Woodland.
Mason County Fruit Growers' Association, Shelton.
Mount Vernon Fruit Growers' Association, Mount Vernon.
North Pacific Fruit Distributors, Spokane.
Northwestern Fruit Exchange, 510 Chamber of Commerce Building, Spokane
Peshastin Fruit Growers' Association, Peshastin.
Pullman Fruit Growers' Association, Pullman.
Puyallup and Sumner Fruit Growers' Association, Puyallup.
Spokane County Horticultural Society, Spokane.
Spokane District Fruit Growers' Association, Spokane.
Spokane Inland Fruit Growers' Association, Keisling.
Spokane Valley Fruit Growers' Co., Otis Orchards.
Spokane Valley Growers' Union, Spokane.

Washington—Continued

Southwest Washington Fruit Growers' Association, Chehalis.
Stevens County Fruit Growers' Union, Myers Falls
The Green Bluffs Fruit Growers' Association, Mead.
The Ridgefield Fruit Growers' Association, Ridgefield.
The Touchet Valley Fruit and Produce Union, Dayton.
Thurston County Fruit Growers' Union, Tumwater.
Vashon Fruit Union, Vashon.
Walla Walla Fruit and Vegetable Union, Walla Walla.
Wenatchee District Fruit Growers' Union, Wenatchee.
Wenatchee Valley Fruit Growers' Association, Wenatchee.
White River Valley Fruit and Berry Growers' Association, Kent.
White Salmon Fruit Growers' Union, White Salmon.
Yakima Valley Fruit Growers' Association, North Yakima
Yakima Valley Fruit and Produce Growers' Association, Granger.
Yakima County Horticultural Union, North Yakima
Zillah Fruit Growers' Association, Toppenish.
—Better Fruit, January, 1913.

FRUIT GROWERS' ASSOCIATION, YAKIMA. See *Marketing*.

FRUIT MARKS ACT, CANADIAN. See *Laws*.

FRUIT MERCHANDISING, ECONOMICS OF. See *Marketing*.

PREPARING FRUITS FOR MARKET

Rules for picking, sorting, packing of various fruits in use by the Yakima Valley Fruit Growers' Association:

Compiled by Charles L. Hamilton.

Picking

1. Care should be used by pickers not to break off the fruit buds for the following year.

2. Never allow the orchard boxes filled with fruit to stand in the sun.

3. Where possible, pick fruit during the coolest part of day.

4. Picking at proper time is just as important as any other part of the work.

(a) Fruit picked too early is usually unfit for food.

(b) Fruit picked too late is usually too ripe for shipment, as in the case of overripe peaches, cots, prunes, plums, etc.

(c) Apples picked after heavy frost do not hold up well.

(d) Rain on fruit that is maturing injures the keeping quality.

(1) In the case of yellow peaches causes them to ripen without showing proper amount of yellow color and often causes them to turn black at pit

(2) Cherries, plums, prunes and cots will ripen and start to decay soon after packing where rain comes at time fruit is almost ready to move.

(3) Pears are affected in the same way as cherries, plums, prunes, etc., but will hold up longer.

(4) Apples that receive heavy rains when maturing will not hold up as long as they would under proper climatic conditions.

5. Care should be exercised in picking the different kinds of fruit so the marketable qualities will not be injured.

(a) CHERRIES:

(1) Cherries should be carefully picked from tree so as to secure part or all of stem.

(2) When picking cherries, all blemished, misshapen, stemless or green fruit should be thrown out by pickers.

(3) Pick into small buckets and pour gently into orchard boxes.

(4) Boxes should not be filled over six inches deep and should never be allowed to stand in sun.

(b) PRUNES AND PLUMS:

(1) Care should be taken by pickers to pick fruit with stems intact.

(2) Pickers should be very careful in picking not to brush off the bloom.

(3) Gloves should not be used in the handling of prunes and plums.

(4) Prunes and plums should be hard ripe for picking, fruit should contain some sugar and be matured enough so it will continue ripening and have a good flavor.

(5) Wherever possible, pack directly out of picking buckets. (Saves handling, protects the bloom).

(c) PEACHES:

(1) Peaches should be hard ripe for picking.

(*a*) White peaches should be in such a condition that they will have lost that deep green cast and show light green or silvery white and be filled out.

(*b*) Yellow peaches, when in condition to pick, should have lost the deep green cast and should show a golden yellow on

the sunny side. They should be well filled out.

(2) Peaches should be laid in basket or bucket, never allowed to drop.

(3) Pickers should throw away all blemished or misshapen fruit.

(4) Baskets or buckets filled with fruit should be hauled from orchard to packing house in a wagon that has a good set of springs.

(5) Peach trees should be picked over from three to five times during season.

(d) APRICOTS AND YAKIMINES:

(1) Should be hard ripe for picking.

(*a*) Should show yellow over most of specimen.

(*b*) Should be matured enough so that it will continue ripening and have a good flavor.

(*c*) Wherever possible pack directly from picking basket or bucket.

(*d*) Where necessary to haul loose fruit in orchard boxes care should be taken in pouring from pail into boxes

(*1*) Place bucket in box, place hand on fruit, tip bucket and allow fruit to roll out gently.

(*2*) Boxes should not be filled over six inches deep.

(e) PEARS:

(1) Care should be taken not to pick fruit before it is in condition to ripen.

(2) Should be green for shipment.

(3) Large growing varieties, such as Bartletts, Flemish Beauties, Clapps Favorite, etc., should be 2¼ inches in diameter, or larger.

(*a*) The first picking of Bartletts, Flemish Beauties, Clapps Favorites, etc., from young trees, should be 2½ inches in diameter, and from the older trees that are heavily loaded 2¼ inches.

(4) Pickers should be very careful in picking to secure the stem of pear intact; by lifting up and out with a light side twist on pear, it will come off spur easily without breaking stem.

(5) Pears should never be poured from bucket into orchard box, but transferred by hand.

(f) APPLES:

(1) Apples should be carefully picked and handled.

(*a*) Care should be used by picker to secure stem of apple intact.

(*1*) By lifting up and out with a light side twist, apple will come off spur easily and without pulling out stem.

(*2*) Lay apple in picking basket, do not drop Every apple dropped bruises two or more. Bruised apples are unmarketable.

(2) Large apples should be transferred from picking bucket to orchard box by hand.

(3) Small apples may be carefully poured from bucket into box. Place bucket in box, tip slowly, holding hand over top of bucket, allow apples to roll out gently.

(4) Apples should not be picked when frosty.

(5) Windfalls, if picked up, should never be mixed with the good fruit.

(*a*) If grower wishes to have windfalls handled, he should first store them away for two or three weeks so that bruises will have a chance to show up.

(*b*) It is impossible to sort windfalls right if direct from orchard.

Sorting

1—GENERAL INSTRUCTIONS:

Sorters should study the rules carefully until thoroughly familiar with them, for on them, next to the packers, rests the responsibility for proper grades, and careful work on their part will make it possible for the packer to put up a good box of fruit.

Packers should be equally familiar with grading rules and should not place absolute dependence upon the work of the sorter. They should look for and lay out the off grade fruit which will sometimes be passed by the very best sorter; on the packer who is the last to see the fruit before it is wrapped and packed in box lies the ultimate responsibility for the proper grade and pack.

2—APPLES:

*(a) Apples should be sorted from orchard boxes into four boxes where the three grades, Extra Fancy, Fancy and C grade, are made; only three boxes will be

* See article on Packing under Apples.

necessary where C grades are not packed. Place the box for the Extra Fancy on the right hand side of the orchard box, box for Fancy on left of orchard box, and where C grade are packed, place a box for them on the left of the box for Fancy, place a cull box on the floor.

(b) Care should be taken by the sorter to mark the grade on each box in such a way that marks will not show when boxes are used for packing and are nailed up.

(c) In sorting, apples should be LAID in the box, not DROPPED.

(d) If one end of the box is filled full of fruit and apples allowed to roll from that end to the other, punctured apples and bruises will be the result.

(e) Where apples are packed into the single grade to be known as Fancy, only two boxes are necessary, one on the right of the orchard box for the Fancy, and one on the floor for the culls. If C grades are to be packed another box to contain them should be placed on left of orchard box.

3—PEARS:

The apple suggestions apply also to pears.

4—PEACHES, APRICOTS, PRUNES, PLUMS, CHERRIES, ETC.:

Sorting out of inferior fruit should be done by pickers in the orchard when picking, and by the packers when packing.

Packing

1. Proper packing is just as important as proper sorting, for a good neat pack helps sell the fruit. Observe these two rules carefully:

(a) Wrap fruit neatly.

(b) Do not mix sizes; failure will mean an unattractive package, which will injure the sale of the fruit. There should be little variation in the sizes of the packed box because the use of different sized specimens makes it impossible to keep all the spaces the same size, consequently the packer loses the alignment and is in danger of changing the pack.

2—CHERRIES—10-lb. Boxes:

(a) In making box, top should be nailed on, bottom left off.

(b) Box should be placed before packer with open bottom up.

(c) Carefully pack the bottom tier, which will be the top when pack is completed.

(d) In packing the first tier, care should be taken by the packer to place the flattest side of the cherry next to the board.

(e) Two boxes should be used. While filling in the first box that has been faced, pick out proper sized fruit to face second box.

(f) Use only the square pack, never a broken one.

(g) Both ends of box must be packed alike.

(h) Keep all stems on first two tiers up, and all stems down on the bottom which will be the top of the box to the packer.

(i) See that the corners are well filled.

(j) After box is nailed up there should be no stems showing. Edges of the box where cherries are exposed should present a packed appearance.

(k) Nailers should be very careful when lidding up not to cut or mash any of the fruit; all such cherries should be removed and replaced with good fruit.

3—CHERRIES in 20-lb or 25-lb. Boxes:

Follow same instructions when packing either 20-lb. or 25-lb. boxes as those given for 10-lb. except that two tiers should be packed instead of one.

4—CHERRIES—Strawberry Crates:

Where strawberry crates or Four Hallock Carriers are used for packing cherries, hallocks should be well filled, shaken down and topped or faced so they will be rounding full. There should be no stems showing. Use square pack.

5—APRICOTS, YAKIMINES, and all the larger varieties of PRUNES and PLUMS, and all such fruit:

(a) Should be packed in four basket prune crates, unless special order is given to put them up otherwise.

(b) Pick as large a percentage as possible with stems on; throw out all stemless fruit where skin is broken or torn.

(c) Fruit too small to pack 6x6 should never be packed in prune crates and

should only be shipped in 4-inch peach baskets where special order is given.

(d) Wherever possible use square pack.

(e) Size of crate 4½x16x17⅝, except for extreme sizes, then increase or diminish depth only.

(f) Care should be used by the packer in placing the paper in the basket. Crate should be placed on packing table with slatted side toward the packer; after four baskets are fitted into the crate, they should have the paper fitted into them in such a way as to cover half the bottom of each basket, allowing the remaining paper to lap over the slatted sides of the crate; after first tier is packed in basket fold paper over it and pack second tier which in turn should be covered by the paper, and the third or last tier packed, after which the remaining paper should be folded over the top.

(g) Pack all Italians and Tragedies three tiers, stem end down; pack top tier with creased sides lined up.

(h) Varieties that will go 4x4 in a square pack, or larger, may be packed two tiers; Hungarians, Bradshaws, Peach Plums and similar varieties smaller than 5x5 should not be packed.

6—CRAB APPLES:

(a) Crab apples should be shipped in apple boxes only, unless otherwise specified.

(b) Double line the boxes and fill in.

(c) Care should be taken by those filling in boxes to keep out all imperfect fruit; boxes, after being well shaken down and nailed up, should have from one to one and a half inch bulge, counting top and bottom.

(d) Never mix varieties.

7—PEACHES:

(a) Pack direct from picking pail or basket into three or more boxes if the fruit does not run uniform in size.

(b) The folded ends of the paper on wrapped peach should go down, as a cushion for the fruit to rest on.

(c) In packing, the boxes should rest on an incline with the lower end to the packer. The peaches in the top tier should rest in the spaces between the peaches in the lower tier, so that no peach will rest squarely on top of another.

(d) In packing the larger sizes, both tiers should be carried forward together so as to regulate the height of the pack.

(e) The stem of the peach should always be packed down.

(f) Each box should show a bulge not to exceed three-eighths of an inch.

(g) The packed box should never be accepted by warehouse where the fruit is loose and the box rattles.

(h) All peaches that go five across the end of the box or smaller should be packed in a 3x3 pack. Those larger than five across the end of box should be packed three by two.

(1) 3x3 Pack. Place first peach in lower left hand corner, the other two to be so placed that the space between the first and second and second and third will be the same size as that between the lower right hand corner of box and the third peach. Place the next three peaches in the spaces formed by the placing of the first three, continuing the pack in the same manner until the tier is finished, always taking pains to see that the spaces are the same size and the alignment of the fruit is perfect. In starting the second tier begin on the opposite side of the box and pack directly over the spaces formed by packing of the first tier.

(2) 2x3 Pack. Start the box with the two and then the three. Place the first two peaches so that the spacing between the peaches and the two corners of the box will be the same as that between the peaches. Place the three peaches in the spaces provided by the placing of the first two. Continue the pack in the same manner, remembering always to keep the spaces the same size and alignment perfect. Pack the second tier directly over the spaces formed by the packing of the first tier.

8—PEARS:

(a) Two or more boxes should be used in packing pears.

(b) Always pack direct from box into which fruit has been sorted, never from a canvas table.

(c) Bartletts and Flemish Beauties should weigh, when packed and nailed up, fifty-two pounds A variation of from fifty-one to fifty-three pounds is permissible if pack is good.

(d) The Clapps Favorite, which is a lighter pear, should weigh, when nailed up, from forty-nine to fifty-one pounds; nothing under forty-nine pounds should be accepted by nailer. Those over fifty-one and not to exceed fifty-two pounds may be accepted if pack is good and lid will go on without cutting or mashing fruit.

(e) Buerre de Anjous and Comice should weigh from forty-eight to fifty pounds.

(f) Winter Nelis should be packed five tier deep, never six. The smaller sizes will be light, often not over forty-six pounds, but are acceptable if the pack is tight.

(g) The weight of the packed box should be regulated by the firmness with which pears are placed in the tier.

(h) The large 3x2s and 3x3s should be packed loosely, while the smaller sizes should be packed tightly. All 4x3 packs should be tight.

(i) Care should be taken by nailer not to cut or crush any of the fruit along the edges of the box; all such fruit should be removed and replaced by good pears.

(j) The proper way to place pears in the box: In starting the tiers of any pear pack, the first row along the end of the box should be laid with the blossom end of fruit toward the end of box, and with the stem pointing directly away from the packer and slightly down; the remaining pears of each tier should be so placed that the stem will be pointing directly toward the packer and slightly up.

(k) Never line pear boxes.

(l) The first tier should always be packed with the smooth wrap of the paper down, that is, the bottom of the box should always be faced so that the nailed up box will present a neat appearance.

(m) The 3x2 pack, 3x3 and the 4x3 should be used in the packing of pears.

*(1) The 3x2 pear pack. All 3x2 packs should be four tiers deep. Start the pack with three pears, placing them in the lower end of box in such a way that there will be one in each corner and one in the center. Place the next two in the spaces provided by the packing of the first three, continue pack in the same manner until the tier is finished, remembering always to keep spaces the same size and the alignment perfect. Pack second tier over first tier spaces, third tier over second tier spaces, and fourth tier over third tier spaces.

(2) The 3x3 pear pack. This pack should always be five tiers deep. In starting the 3x3 pack, place the first pear in lower left hand corner of box, the other two to be so placed that the distance will be the same between the first and second and the second and third as that between the third pear and the lower right hand corner of box. The next three pears are placed in the spaces provided by the placing of the first three, and continue the pack in the same manner until the tier is finished, remembering always to keep the spaces the same size and the alignment perfect. The second tier is to be packed over the first tier spaces, the third over the second tier spaces, the fourth over the third tier spaces, and the fifth or last tier over the fourth tier spaces.

(3) The 4x3 pear pack. This pack should always be five tiers deep. In starting the 4x3 pack, place a pear in each of the two lower corners, the next two to be so placed that the spaces between the two corner pears and the two inner pears will be the same size as the space between the two center pears. Place the three pears in the spaces provided by the placing of the first four. Continue to pack in the same manner until the tier is finished, remembering always to keep the spaces the same size and the alignment of the fruit perfect. Pack the second tier over first tier spaces, third over second tier spaces, fourth over third tier spaces, and fifth over fourth tier spaces.

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* See Packing under Apples

9—APPLES·

(a) From two to five boxes should be used when packing apples.

(b) Always pack direct from orchard or peach box into which apples have been sorted, never from a canvas table

(c) A box should be placed in a convenient position to receive the odd sized apples for which no box has been started There are 20 or more different apple packs so it will readily be seen that all the different sizes cannot be packed at one time

(d) All apples should be packed on cheek with the stem directly from the packer Never allow the apples to slip sideways, as that brings the stem of one apple in contact with the side of another, often causing punctures; it also fills up the spaces and changes the alignment of fruit

(e) To regulate the height of apples on end of box, place the end apples in the box in such a manner that the shortest diameter from cheek to cheek will come directly up and down; after packing the first two rows next to end of box in such a manner, apples may be turned so the greatest diameter from cheek to cheek will be up and down. If packed in this way, the box when finished will have a good bulge and the ends will not be too high.

(f) A bulge of from one to one and a half inches on all packed boxes, counting top and bottom, is required.

(g) Loose packed boxes, as well as those that are too high, should not be received at warehouse except for a repack.

(h) Apple Packs—2x1, 2x2, 3x2 and 5 tier straight

(1) The 2x1 pack takes care of all those apples that are larger than three across the end of box. Pack should be three tiers deep. Start the box with the two, one in each lower corner of box next to packer. Place the one in the space between the two corner apples; then place next two in the spaces on either side of the one. Continue pack until tier is finished, always remembering to keep stems directly from packer, spaces same size, apple on cheek, the alignment perfect, and the apples in their tier firmly held in place by the pack. The second tier is to be packed over the first tier spaces and the third over the second tier spaces.

(2) The 2x2 pack takes care of all apples larger than four across the end of box and those that are just large enough to go three across the end. They should always be four tiers deep

Place first apple in lower left hand corner of box, the next to be so placed that the space between it and the first apple and the space between it and the lower right hand corner of the box will be the same size. The next two apples to be placed in the spaces provided by the placing of the first two; continue pack in the same manner until tier is finished, always remembering to keep stems directly from the packer; spaces the same size, apples on cheek, the alignment perfect and the apples in the tier firmly held in place by the pack. The second tier should be placed over first tier spaces, the third over second tier spaces, and the fourth over third tier spaces.

(3) The 3x2 pack takes care of those apples larger than five across the end of box and up to and including those that will just go four across the end.

Place first three apples in the lower end of box next to packer in such a manner that there will be one in each corner of box and one in center. The next two to be placed in spaces provided by the placing of the first three. Continue the pack in the same manner, always remembering to keep the stems directly from packer, apples on cheek, spaces the same size, the alignment perfect, and the apples in the tier held firmly in place by the pack. The second tier should be packed over the first tier spaces; the third over second tier spaces; the fourth over third tier spaces, and the fifth or last tier over fourth tier spaces.

(4) The five tier straight pack takes care of all those apples that are just large enough to pack five across the end of box. It is the only apple pack to be used where one apple rests squarely on top of another apple.

10—NAILING UP:

(a) The nailer should be thoroughly familiar with the rules because he is the last person to handle the box before the lid is nailed on. It should be his place to turn back to the packer those boxes that are not properly packed; those that are too high or too low, or those in which pack has been changed. He should also be able to tell whether the sizes are mixed and if so send them back for a repack. Unattractive packs, that is, those in which the fruit has been poorly wrapped, should not be accepted by him.

(b) Care should be taken by the nailer not to injure the fruit in the pack-box by the manner in which he nails it up.

11—TIERING ON RANCH·

(a) Wherever possible the nailer should stack the nailed up boxes away in such a manner that each size, grade and variety will be separate.

(b) The 10-lb. cherry boxes should be stacked with top down.

(c) Apples and pears should always be stacked on side with all the markings one way

(d) Prune crates, strawberry crates and peach boxes should always be stacked so that the weight comes on the cleats; all stamped ends should be one way in stack.

12—HAULING INTO WAREHOUSE:

In loading wagon with fruit to be taken to warehouse or to a car, each load should contain boxes of the same size, grade and variety as far as possible; that is, do not mix sizes, grades and varieties in a load if a load can be made up otherwise.

There are certain places in the warehouse marked off for each variety, each size and each grade. If in making deliveries to the warehouse two or more varieties, two or three grades of each variety, and six or ten sizes of each grade are made in the same load, there can be only a few boxes to go into each stack. Consequently when fruit is loaded into car, only a few boxes of that one load can be run into it, and when returns are made on fruit it will be found that the one load may be divided into eight, ten or even more parts and sent out in that many different shipments.

SETTING AND DROPPING OF FRUITS

One of the discouragements in fruit growing is the uncertainty which attends the formation and development of fruit buds. Failure to set fruit even though the trees bear an abundance of blossoms, the dropping of immature fruits, the biennial bearing habit of certain apples and unfavorable weather at blooming time, are common and seemingly unpreventable drawbacks to profitable fruit growing. The Biblical injunction "to dig about and dung the trees" may be obeyed both literally and figuratively and yet the trees may fail to blossom, or to set a crop, or the fruit drops, or wind, rain, cold or frost may destroy the embryonic fruits. Indeed, seemingly, the better the culture, the greater the retrogression in sexual reproduction, and the forces set in motion by the cultivator in no way nullify the effects of bad weather.

Roughly the above problems fall under two heads· First, those having to do with the formation of fruit buds; second, those having to do with the development of the buds.

Controlling Fruit Buds

Can the fruit grower influence the formation of buds? Though he cannot wholly control the formation of buds, he can at least greatly influence their formation. We may lay down as the first principle having to do with the formation of fruit buds, one founded on the experience of fruit growers with practically every fruit· that plants develop fruit buds only where there is a store of food materials in twigs and branches. Another statement to much the same effect is that plants will not form fruit buds when the food material is being largely used in the production of new wood and new leaves.

Many facts and horticultural practices substantiate the statements just made. Thus, trees unduly luxuriant in growth do not set fruit; plants without sufficient food for both wood and fruit bearing do

not as a rule produce fruit; in warm, damp climates trees and vines grow to great size and with much foliage but bear little or no fruit; pruning, which is favorable to wood growth, is antagonistic to fruit production. Plants that are producing too much wood and foliage and too little fruit may be subjected to several treatments to induce them to bear fruit.

Water Supply

Regulation of the water supply sometimes induces the formation of fruit buds. In the irrigated regions of the West, vegetative growth may be stopped by withholding water and the setting of fruit buds thus be materially influenced. It is a matter of common observation everywhere that a dry season is more conducive to the formation of fruit buds for the ensuing season's crop than a wet one. The water supply in unirrigated regions may be regulated only through drainage, but fortunately drainage may often be made an important means of inducing early fruitfulness and a fruit-bearing habit. Other things being equal, trees on wet, sodden soils do not bear fruit early in life and do not set fruit regularly and in proper quantities. Under such conditions there is insufficient food for either wood or fruit production. The remedy is obvious and the subject needs no further discussion.

Light

Much can be done in securing the proper formation of fruit buds by giving the trees an abundance of light. The outside row in an orchard, where the trees have most light, usually bears the most fruit. It is true that these isolated trees have more food and moisture as well as more light and because of these two factors, also, many buds set. Yet light must be counted as important and is to be secured by proper spacing and by developing open-headed, well pruned trees.

Food Supply

The food supply has much to do with the formation of fruit buds and probably the most rational procedure under average orchard conditions to induce fruit bearing is to regulate the supply of food. With the widely varying conditions of different orchards, this is not easily done. It does not appear from any information that we now have that there is a storage of particular food for fruit buds and of other food for wood growth, but rather that stored food is quite as available for one sort of growth as for the other, yet it is generally supposed that the kind of food given plants influences the amount stored and consequently, the number of fruit buds formed or the amount of growth made.

Briefly, the behavior of foods upon manner of plant growth is supposed to be this: An abundance of food, especially if it contains nitrogen, and if at the same time there be a plentiful supply of water, is most favorable to the formation and growth of cells, hence of wood and leaf growth. If the amount of food be decreased, and more particularly if the nitrogen as compared with the potash and phosphate be decreased, and especially if there be an increase of light and air, wood growth is lessened and the number of fruit buds is materially increased.

Sometimes the excess of food and moisture is already in the soil and the problem then is to reduce the quantities and so bring on fruit-bud formation. The orthodox method of reducing the quantity of plant food and soil moisture is to sow a grain crop in the orchard. The trees under such treatment cease to make wood growth and use the assimilated substances in the making of fruit buds. This procedure, it should be said at once, is seldom necessary.

The fact that leaf and wood growth and fruit bearing in plants are opposed to each other is well recognized by fruit growers; but the knowledge is quite too often wrongly used, exemplifying again that "a little learning is a dangerous thing." Thus, to bring trees into bearing is often the owner's excuse for double-cropping orchards, putting an orchard down to sod and withholding proper cultivation.

Pruning

Pruning often materially aids in causing the storing of plant food for the

formation of fruit buds. One of the general aims of pruning is to regulate the crop of fruit by removing parts of the plant that those remaining may store the necessary food. The theory of pruning to cause formation of fruit buds is simple but the practice is not so simple. The effects of pruning are so varied under different conditions that it is exceedingly difficult to give directions as to its use in influencing the setting of buds.

Heading-in may sometimes be used to advantage in pruning for fruit. It consists in cutting back young, unbranching shoots which set few or no fruit buds Heading-in is a necessity with dwarf trees. Practice differs as to whether the operation should be performed in summer or winter but it is usually performed in summer and is then spoken of as summer pruning. Heading-in greatly thickens the top, thereby excluding light, and must be practiced very judiciously or more harm than good is done.

Summer Pruning

Summer pruning is rather commonly used to influence the formation of fruit buds for the succeeding season. The theory is that by removing a part of the young shoots of the current season, we take from the trees the portions which are making the greatest demands on the plant's nutritive powers and that the remaining parts of the shoots with their buds are enabled to store up greater quantities of reserve food than they otherwise could. This summer heading-in should be done before growth ceases. So much, however, depends upon several varying factors that no fixed rule can be given as to time; thus, much depends upon the fruit, the varieties, soil, climate, weather and the amount of growth.

Summer pruning is a weakening process and may permanently injure a tree in our climate. With standard trees it is only of advantage in moderation in eastern North America and as usually practiced more often results in evil than in good. Summer pruning is of more value in the early life of the tree than later on. Summer pruning as means of inducing fruitfulness is greatly overestimated under American conditions and belongs more properly to the elaborate systems of pruning and training practiced by Europeans.

Ringing

Those who do not find pruning a sufficiently drastic method of checking wood growth to augment fruitfulness may resort to the removal of a ring of bark from the trunk of the tree. In rather extensive experience on the grounds of this station, we have found ringing of some use with the apple. Our practice is to remove a ring of bark from one-half to one inch wide from young apple trees at the period when the trees are making the greatest growth, usually about the middle of June. If the ringing is done earlier in the season or later in the season than June, injury is certain to result. Should it be done when the growth is being checked by drought, injury would also result.

The theory upon which ringing is based is simple. Crude sap passes from the roots to the leaves through the outer layer of wood. In the leaves this crude material is acted upon by various agencies and transformed into food substances. This accumulated material passes downward through the inner bark to be distributed throughout the plant where needed. When trees are ringed the flow of sap upward through the wood continues as before the operation, but the newly made food-substance can not pass below the girdle and, therefore, accumulates above and is used for the formation of fruit buds, though at the expense of other parts of the plant.

Heredity

Is heredity a factor in bud formation? Can the fruit-bearing habit be passed down from one tree generation to another? Can the habit be augmented and intensified by selection? Individuals in an orchard vary as to time of coming into bearing, regularity of bearing and number of buds formed in any season. But it has not been proved that buds chosen from the trees best in these respects would produce trees that are early bearers, or more regular in bearing or more

fruitful. The present trend of science is against such a possibility. Even were it possible, there are a number of practical drawbacks.

Thus, from tree generation to tree generation constitutes a period of time too long for most men to bend their efforts, especially with that clear conception of exactly what is wanted that is required in the intricate problem of plant selection. The variations at best are but slight and hundreds of trees would have to be examined to find one or two from which to start a new race. One would have to make sure, too, that the selected plants would not fall behind their fellows in other characters. The variations mentioned are almost certainly the result of environment and are not passed on from one tree generation to another so that, even were the obstacles not so great in practicing selection that few men would be able, or would take the pains to surmount them, heredity could not be counted as a factor in causing the formation of buds.

Biennial Bearing

Another phase of the subject of fruit-bud control is the biennial bearing habit of some varieties of the several fruits and especially of the apple. So marked is this habit in apples that we can ascribe it as one of the characters of that fruit. A good deal of attention has been given by orchardists and experimenters to biennial bearing in apples, but as yet no one has been able greatly to change nature's way. It is maintained by some that the biennial bearing habit is due to the heavy crop which exhausts the tree's energies and that a light crop follows because of such exhaustion. This can be but partly true; for all can call to mind two, three, or four heavy crops of some varieties after which the trees settle down to bearing in alternate years.

Thinning

Nor does thinning, often proposed as a remedy for overbearing, prove of much value. Pruning seems to alter the condition but little. We have on record several experiments in which blossoms were stripped from the trees during the bearing year to cause the setting of fruit during the off year. The trees so treated usually bear some fruit the off year but seldom a satisfactory crop. Nor is the matter one of food supply. Orchards amply supplied with food are not always annual bearers. Peculiarities of the season have something to do with alternate bearing but do not wholly account for it Eliminating all the above conditions—admitting, however, that all have some influence of the bearing habit—we must conclude that the biennial bearing habit of apples is a peculiarity of the species. Good cultivation, an ample supply of food at all times, careful attention to pruning and training, proper control of pests and systematic thinning, are all means which can be used to some extent to circumvent nature.

Development of Fruit Buds

Leaving now the formation of fruit buds, let us see what can be done to control the development of fruit buds.

Blooming, the prelude of fruiting, had little significance to the fruit grower until the discovery was made that many varieties of several fruits were unable to fertilize themselves and that failures of fruit crops were often due to the planting of infertile varieties. The knowledge obtained by experimenters in this field has to some degree modified the planting of all orchard fruits. Pollination and fertilization are events which take place in blossoms that must be reckoned with by fruit growers.

Pollination

It is necessary to distinguish between pollination and fertilization, terms supposed by many to have the same meaning. Pollination is the dusting of the stigma, the female organ of a flower, with pollen, the male element. Fertilization is the process in which the male cell unites with the female cell. Fertilization takes place only after pollination, but a flower may, of course, be pollinated and fertilization not take place, a fact always to be remembered. Fruits set and develop, for most part, only after fertilization. The young fruits when first formed have but a slight hold upon life. Un-

favorable influences, no matter how slight, may cause them to perish. Fertilization gives the tiny fruit life, and enables it to hold upon the parent plant through nourishment drawn to supply the embryo which has been formed in the seeds. Thus fertilization usually, not always, determines whether a fruit is to develop or to drop. Shortly after blooming time, we have the fruit "drop," resulting for most part from a lack of fertilization

But fertilization does not insure the complete development of fruit. Even after a perfect union of male and female cells, so far as it can be determined, much fruit drops in every orchard and without regard to whether the trees bear few or many blossoms.

Crops of many varieties of several fruits do not set because of the infertility of the blossoms—that is, with many fruits pollen may be produced in abundance, seemingly perfect in appearance, and potent on the pistils of other varieties, but which may wholly fail to fertilize the ovaries of the variety from which it came. There is a great difference in the quantity of pollen produced by the varieties of the several fruits, but it is doubtful if insufficiency of pollen is a factor of much importance in the failure of trees to set fruits.

Varieties that do not set fruits often have abnormal or abortive pistils or stamens. A high percentage of abnormal flowers nearly always indicates a weakness in fruit setting. Another cause of the failure to set fruits is the difference in time of maturity of stamens and pistils. When these organs do not mature at nearly the same time, fruits do not set unless pollen is supplied from some other source. The female organs of fruits are receptive, however, for several days and the pollen is not shed at once from all anthers and is produced with such prodigality as in most cases to insure the pollination of late maturing stigmas.

The solution of the problem of self sterility in the main, then, is to so plant that varieties will be cross-fertilized. It is obvious, if cross-pollenization is to play an important part in fruit growing, in planting to secure it varieties must be chosen which come into blossom at the same time as those that they are expected to fertilize.

There are several causes of dropping other than lack of fertilization that need the attention of fruit growers.

Weather

Weather conditions have much to do with the dropping of fruit. Prolonged cold saps the vitality of young fruits and causes many of the more tender ones to perish and let go their hold upon the tree. Rain, whether a dashing shower or a prolonged drizzle at a low temperature, or even an extremely moist atmosphere without a fall of rain, weakens the chances of full development of fruits if such conditions prevail soon after fruit formation. Sometimes a lack of light causes fruit to drop, and thus we may explain the greater number of fruits at the tops of trees, on well pruned trees, in open-centered trees and in orchards not thickly planted.

"June Drop"

The "June drop," especially of the peach, may be explained in part as follows: When fruits reach a certain size the food stored in the tree the previous year is exhausted. Now if the leaves of such trees are not fully expanded and if they are not able to furnish a new supply of food, the young fruits often drop. The June drop is especially liable to take place if there be one or more of the unfavorable conditions mentioned in the previous paragraphs. With some fruits there is a tendency to drop in late summer when seeds are making great demands for food. In such cases the trees become exhausted and cast a part of their load. If at this time there be a drought, or, on the other hand, too much rain, as is often the case, fruit not infrequently drops in considerable quantities.

It seems worth while with trees which habitually drop their crop to try to direct the food to the fruit-bearing branches by pruning out surplus wood, cutting out water-sprouts, and stimulating the growth of fruit buds the previous season. All factors which are con-

ducive to the best nutrition of the tree influence its capacity to retain the crop.

Insect and Other Injury

Fruits often fall because of insect or fungus injury to tree or fruit. The effects of serious injury to the foliage or the puncturing of the fruit by any one of the innumerable insect pests are too well known to demand attention, though insect injury must by no means be thought to be a sure cause of the dropping of a crop. Some insects, as codling moth, curculio, and the berry worms may remain until the fruit is fully developed.

Overloading

Lastly, it may be of distinct advantage for a tree to drop a part of its load if it have more fruit than it can bring to the best maturity. If it does not do so naturally, the fruit grower should take the matter in hand and thin the crop.

Frosts and Weather

The weather, as we have indicated in a previous paragraph, has much to do with the setting and dropping of fruit. A study of the weather as it affects the formation and development of fruit buds was made at this Station several years ago covering a period of 25 years beginning in 1881.* Since the report of this study can no longer be had the main conclusions are again published here.

During this 25-year period late frosts ruined the fruit crops in Western New York in four years, seriously lessened the yield in five years, and did much damage to pears, peaches and plums in three other seasons. That is to say, in more than half of the 25 years, "unreasonable" frosts caused serious loss to fruit growers over the section as a whole. The years of frosts appeared in cycles, as there was but one harmful frost during the first eight years of the 25, then for six years in succession the crops were damaged seriously, while during the latter half of the period the frosts were more evenly distributed.

* U P Hedrick, Bulletin No 299 New York Agricultural Experiment Station, March, 1908

During seven years when frosts did little or no harm, cold, wet weather played almost as disastrous a part and reduced the crops to unprofitable proportions; while in five of the years of frost the damage was increased by the effects of cold storms. These storm years, like the frost years, came in cycles. A first short period of three years, beginning in 1881, was marked by storms, as was a longer period of seven years beginning in 1888 During the first period, wind strong enough to harm the blossoms, even without the accompanying rain, was a feature of each season, as was also the case in 1905; while in another year, without injurious rain storms, the wind alone did considerable harm to blossoms.

Sunshine at blooming time, with warm, dry weather, marked five years, only, of the 25; and in each of these years the crops were excellent. In three of them the records were broken for one or another of the fruits and enormous yields were secured from practically all fruits.

From these facts, and more detailed data given in the original bulletin, we must conclude that rain and the cold and wind that usually accompany it in mid-May cause the loss of more fruit than any other agency. Killing frosts take second place as destructive forces, though the sudden, plainly evident harm they do attracts more attention and causes more complaint than the slowly developing, more concealed damage from a long, cold storm without freezing temperature.

Frosts usually blacken and destroy immediately the reproductive organs of the flowers, giving very plain evidence of harm; but such evidence is often given undue weight, so that the injury from light frosts is frequently overestimated.

Cold storms, or even very cool days without frost, at blooming time lessen or destroy the crop in several ways. The rains wash off the tiny grains of pollen from the delicate anthers of the flowers and thus prevent their journey on the body of some insect, so that they fail to perform their fertilizing office. Even if a pollen grain chance to reach the pistil

it may fail to adhere and grow since the rain also washes off and dilutes the adhesive, stimulating secretion upon the stigmas. Provided neither of these causes prevents the journey and proper placing of the pollen, the cold of such storms often so lessens the vitality of the grains that they germinate very slowly or not at all.

The cold and the rain also check the activities of bees and other insects, and as these are the effective carriers of pollen grains, the possibility of successful pollination is still further lessened.

Dampness is favorable to the growth of most fungi—which cause our leading leaf and fruit diseases—and such fungi frequently attack and ruin flowers during May storms.

Winds, alone, do comparatively slight harm to fruits early in the season, but occasionally are strong enough to whip blossoms from the trees and to prevent the flight or active work of insects. If they are drying and long continued they may evaporate the secretion from the stigmas and thereby prevent the retention and germination of the pollen; while cold, dry winds from the north at blooming time chill vegetation and retard all plant activities. On the other hand, light breezes on nights when frosts would otherwise occur may sweep away the settling chill and prevent damage; or, in favorable localities beside large bodies of water, may bring in clouds or fogs to check heat radiation and prevent freezing.

Unfortunately, at least in a narrow sense, man cannot control the weather to any great extent. Orchard heaters are now used to warm the temperature of an orchard and prevent frosts. By small fires, especially of damp, smouldering, smoke-producing materials, orchards and vineyards may occasionally be protected from light frosts. By proper placing of windbreaks—not so simple a matter as it may at first appear—some advantage may be given tender fruits. By whitewashing the trees in early spring, blossoming may be retarded a few days. A definite amount of heat is necessary to bring buds to maturity, and since white objects absorb less heat than dark ones, such whitening of the trees may occasionally carry the buds unopened safely through a frost that would destroy the flowers.

Aside from these comparatively unimportant exceptions, we can do nothing, after the orchard is established, to protect fruit trees from weather stresses. But we can do much to protect future fruit crops by careful study, before we locate the plantation, of weather conditions and crop adaptations. It would be most unwise to set apricots, plums and peaches, which are relatively tender at blossoming, in any locality where the average date for the last killing frost is as late as May 10; yet some late blooming or cold resistant varieties of even these fruits, on some hillside rightly located or beside a favoring lake, might escape frosts often enough to make their culture highly profitable since they could be sold in near markets never glutted with such fruits because of general unfavorable conditions.

Orchard Site

In choosing a location for an orchard we must consider latitude, altitude, and general topographic conditions, especially proximity to large bodies of water, since these all affect general climatic conditions.

Perhaps fully as important as general location, however, is the choice of a particular field on which to plant fruit trees or grape vines. Omitting all discussion of soil, markets, roads, and other surroundings, the lay of the land may frequently determine its value for an orchard or vineyard. Every fruit plantation has a local climate varying in the different parts of the tracts in accordance with the lay of the land. Low lying spots show the greatest extremes—lowest temperature in cold weather and highest temperature in hot weather. Conversely, on the elevated portions of a tract the temperature is most equable—less cold in low temperature, less hot in high temperatures. The direction of the slope of the ground causes variation in the

temperature probably because of the greater amount of heat absorbed from the sun by southerly slopes and because of the different exposures to prevailing winds. A slope also gives better air drainage than a level. The difference between high land and valley, slope and plain, is often amply sufficient to account for the idiosyncrasies in frost injuries so often noted.

Some fruit growers in the state claim to obtain a certain degree of immunity from frost through good air drainage secured by planting at a sufficient distance so that tops do not touch and by keeping the heads within bounds by pruning.

Quite as essential as location in doing the little that can be done to avert frost injury is the selection of varieties. Some varieties of each of the several fruits blossom later than others and these are usually in least danger of frosts. The length of time during which different varieties are in blossom is worth considering, though it varies considerably in accordance with the fruit, the variety, and, most of all, the weather.

The average length of the period of bloom for the different species of fruits is: For apples, about nine days; for pears, seven days; for peaches, eight days; for plums, seven days; for cherries, seven days, and for grapes, ten days. The time from first blossoms until all have dropped may vary greatly, as the blossoms of some fruits do not last longer than 48 hours in very hot, dry weather. Blossoms of tree fruits, after opening, do not close night or day, though pollination probably takes place during the day only.

Other things being equal, of course it would be in the fruit grower's favor, in a locality where late frosts are liable to occur, to select late-blooming varieties. Such varieties cannot be selected by knowing only their time of ripening; for some early fall apples blossom late, like Williams, and some late winter apples blossom early, like King and Wagener. That is, there is no corelation between the time of blooming and the time of ripening of fruits. Early varieties do not necessarily, though some may, blossom earlier than late varieties. It is not possible, therefore, by selecting late varieties to escape danger from late frosts.

Circular 22, New York Experiment Station, Geneva, N. Y.

Fungus

A thallophytic plant destitute of chlorophyl, and deriving nourishment wholly or almost wholly from organic compounds, as a mushroom, toadstool, puff ball, mold or mildew.

The fungi reproduce chiefly by sexual spores. They are divided (1) morphologically, into three classes: Phycomycetes, Ascomycetes and Basidiomycetes; and (2) physiologically as parasites and saprophytes. Their chemical composition is complex and variable. They contain proteids, cellulose, gums, oils, sugars, acids, enzymes, resins, alkaloids, and various pigments, but no starch. More than 40,000 species have been described; many of them microscopic. Some are edible, others poisonous; the antidote being atropin, stimulants or heat. Many have no economic interest; others cause diseases of plants and animals.

Pathol.

A soft, spongy, morbid growth of abnormal excrescence.

Algal fungus (Bot.)

Any phycomycetous fungus.

Bracket Fungus, n.

A fungus of the order *Agaricales* growing on a tree trunk, resembling an inverted bracket, as others of the polypori.

Cap Fungus, n.

A fungus with an expanded part, called the pileus, or cap, supported by a stem; a mushroom or toadstool.

Fungi imperfecti (Bot.)

Imperfectly known fungi, or those whose true character and relationships are unknown; 400 genera are included in the three orders, *Sphaeropisdales*, *Melanconciales* and *Moniliales*, into which they have been divided.

Fungus Beetle, n.

A beetle that lives in or upon fungi, as an *endomychid* or *Mycetophagid.*

Fungus Cellulose, n

The cellulose found in fungi; a term used by De Barry and others. It always resists the action of ammoniacal copper oxid, but has the same chemical composition as ordinary cellulose.

Fungus cerebri (Pathol)

Hernia of the brain.

Fungus Disease, n.

Mycetoma.

Fungus Gnat, n.

A minute mycetophilid gnat, whose larvae inhabit fungi.

Fungus Midge

Fungus Hematodes

A soft bleeding or ulcerating *carcinomatous* tumor of rapid growth.

Fungus Pit, n.

A pit for growing mushrooms or other fungi.

Fungus Stone, n.

A mass of earth and mycelium, used for propagation (as of the *Polyporus tuberaster* in Italy).

Fungus Tinder, n

Tinder made from a fungus, as from *Polyporus igniarius.*

Hedgehog Fungus

Same as hedgehog mushroom.

Horsetail Fungus

Same as horsetail mushroom.

House Fungus, n.

Any saprophytic fungus growing on moist wood in houses.

Milk Fungus, n.

Any species of *Lactarius*, a genus of *agarics*, yielding white or colored juice. *L. volemus* and *L. delicious* are edible.

Shelf Fungus, n.

A fungus attached to its supporting surface like a shelf.

—*Standard Dictionary*

FUNGI. See *Diseases of Various Fruits and Vegetables.*

FUNGICIDE. See *Spraying.*

Galls

A gall, in the botanical sense, is an excresence on a plant due to some injury, from instruments as in cultivation or grafting, or from animals, insects, bacteria or fungi.

The disease manifests itself in a callous growth, or hypertrophied tissue on some part of the tree or plant. In some respects it resembles, in relation to plant life, the tumor on the animal organism. Some galls are caused by bacteria, as in the case of crown gall (*Bacterium tumefaciens*). Some are caused by toxins injected by an insect that injures or punctures the bark, others are caused by the mechanical irritation of the plant cells as in the case of sucking insects like the woolly aphis.

Crown galls, so called because they most frequently occur on the crown of the plant, may occur anywhere on the plant. The organism causing crown gall is a bacterium and all galls so caused are called "Crown Galls" wherever they appear. Naturally we would suppose "Crown Gall" was on the crown, no matter what were the causes, but according to the literature of the subject it might be on the lateral roots, the trunk or the branches.

Some Causes That Produce Galls

Gall Fly

1. A kind of insect which stings the plant in laying its eggs.

Gall Midge

2. An insect that punctures the bark, leaf or surface, and deposits its egg in the cavity. The subsequent growth, constituting the gall, is either the effect of some virus deposited with the egg or of the irritation caused by the larva which lives in the gall until it has completed its development.

Gall Louse

3. An aphid which often infests the roots of orchard trees, forming what is generally called "Aphis gall."

Apple Gall

Quercus infectoria

4. The gall or oak apple of the gall oak.

Gall Beetle

5. A beetle that produces galls by puncturing the bark.

Gall Moth

Gelechia pinifolia

6. A gall making moth, similar to a "Clothes moth."

Gall Fungus

7. Any fungus of the order *Chytridiaceae*, that causes galls in plants, specifically, one producing a disease in cranberries and related plants.

Gall Bacterium

Bacterium tumefaciens

8. A bacterium that seems to be always present with crown gall and may infect healthy trees with the disease.

Gall Worm

9. The Nematode eel worm. It is not properly an insect but belongs to that class of animals known as *Vermes*. It attacks the potato more generally perhaps than any other field crop and this may be an objection urged against planting potatoes among orchard trees, unless under conditions where the freezing of winter would kill the worms.

Fig. 1. Crown Gall on Roots of Apple Trees.

Forms of Crown Gall

*Hedgecock says that the different forms of gall, such as "hard gall," "soft gall," and various other forms and varieties of the disease such as are found on raspberries, blackberries, the peach, apple, etc., also the hairy root galls, are but varying forms of the same disease. Though the disease varies in the different plants and different stages of development, yet in all cases it is the same in character, produced by the same causes and always somewhat contagious. Hence in no case should shrubs bearing this crown gall be allowed to go into the trade. Like nearly all bacterial contagious affections, the only safe way to treat it is to absolutely bar its entrance.

Economic Effects of Crown Gall

†Stewart says that "Crown Gall, *Bacterium tumefaciens*, in New York is common on apple trees as well as on several other woody plants. During 12 years of experience he has never known of a well authenticated case in which crown gall has seriously affected apple trees in the orchard." In 1899, C. H. Stewart & Co., of Newark, N. J., set out an experimental orchard of 500 trees, mostly Baldwins, all affected with crown gall. The trees have now been set nine years, and show as good growth as the trees planted at the same time and free from crown gall. The bark is smooth, healthy in appearance and the trees look thrifty and vigorous.

"In 1901, we planted 22 apple trees affected with crown gall to determine the effect of this disease upon the growth of the trees. The trees were three years old. The galls varied in size from one to two inches in diameter, and were located mostly on the tap root, but in a few cases on the lateral roots. Some of the trees had several galls each. We believe the galls were typical of those found on the trees of New York nurseries. Five of the trees were dug up in 1903, five in 1905, and five in 1907. In no instance was there any evidence that the galls had increased in size or number or that they had been in any way injurious to the trees. Probably apple trees bearing large galls should be rejected, but unaffected

*Bureau of Plant Industry, Bulletin 186.

† New York (Geneva) Experiment Station, Bulletin 328.

trees from the same lot may be planted without fear of bad results."

On the other hand, *Thompson, of Mississippi, puts crown gall among the most serious apple diseases.

Our observation leads us to the conclusion that more crown gall occurs in our apple orchards, in connection with "Root grafting," than is generally supposed Often the graft fails to properly unite and a favorable opportunity for the entrance of the bacteria is presented. Great care should therefore be exercised in the grafting of nursery stock.

†W. B. Alwood has given the results of experiments made with crown gall in grafting on diseased and healthy roots. Experiments showed:

1. That there is practically no difference in the susceptibility of varieties to infection.

2. Experiments with grafting diseased scions on diseased roots cut into three sections.

(1) The top cut, only five lived. Three showed cases of crown gall, and two were weak.

(2) Of the middle cut, only six grew, and these were weak, and all showed cases of crown gall.

(3) Of the third cut or tip of the roots, only one survived, and it had gall.

3. Healthy scions on healthy roots.

(1) From the first cut 11 strong healthy plants.

(2) From the second cut eight strong healthy plants.

(3) From the third cut five plants developed, four healthy and one weak. There was not a case of crown gall in the lot.

4. Healthy scions with long roots, onto diseased roots, set in the ground at considerable depth, to see if the disease would be communicated from the lower diseased root, to the healthy upper root. It was not so communicated.

5. The diseased root of No. 4 was cut off the following year, and the healthy part planted. This developed no disease the second year.

* Mississippi Experiment Station, Bulletin 147

† Virginia Experiment Station, Bulletin 140

6. Healthy graft on healthy root, but a piece of crown gall was bound to the root at the point of contact with the graft. Three out of 12 show crown gall, the other nine are healthy.

7. A healthy scion on a healthy root, and a thin slice of diseased tissue was inserted under the bark. Out of the 12 planted, six grew and four showed more or less traces of gall.

8. Twelve healthy scions were grafted onto healthy roots and inoculated with gall. Nine showed decided cases of crown gall, one suspicious and two healthy.

9. Healthy scions were grafted onto healthy roots. After planting, some fresh galls were sliced with a sharp knife and used for inoculating the soil about the trees. Eleven plants grew, all healthy except that two of the plants show incipient cases of crown gall.

10. Galls were cut away with a sharp knife. They have developed fibrous roots, but no normal roots. The part of the roots below the cut seems atrophied.

Pocket Gophers and Crown Gall

*Soft crown gall occurs frequently on roots injured by pocket gophers or mice. Of course the abundance of soft tissue in the root knots would probably lead a rodent to attack the diseased parts rather than a smooth healthy root. Yet, the fact that in some orchards, crown gall is rare except in trees whose roots have been injured by mice seems to indicate that the disease is more commonly the effect rather than the cause of animal attack.

N. Hollister, of the Biological Survey, writing from Banning, California, May 5, 1909, stated that in that vicinity almond trees are killed by root knot, or crown gall, and he sent photographs of a four-year-old tree that had died from this disease. The old gopher tunnels had extended to its roots and no doubt the roots had once been injured by these animals.

From what is now known of the nature of this disease, and the fact that it occurs commonly on trees once injured but

* David E Lantz, in the Year Book, Department of Agriculture, 1909

not killed by gophers or mice, it is safe to conclude that it is often caused by the attacks of these animals.

Crown Gall on Almond

†R. E. Smith reports crown gall on the almond in California as somewhat serious. "Large swellings appear on the main roots just below the ground and to some extent on the smaller roots. This results in a gradual failure and dying of the trees. This is one of the commonest troubles of our stone fruit trees, being found both in the nursery and on the mature orchard soils. The organism would seem to be abundant in California soils, since cases are not rare of infection on the roots of trees grown from pits in virgin soil."

Woolly Aphis Galls

*R. I. Smith, in treating the subject of woolly aphis, says: "The woolly aphids occur in damaging numbers, principally on the roots, and are responsible for the stunted, unhealthy growth and even death of hundreds of apple trees each year. In spite of this, their presence often remains unnoticed except by orchardists who give strict attention to the condition of their trees. The extent of the damage must be far greater than is commonly supposed, when the number of infested trees in nursery blocks, together with those in both young and older orchards is considered. In short, the woolly aphis is one of the most serious apple pests, ranking with the San Jose scale and the codling moth.

For Description of Woolly Aphis, see *Aphids*.

Similar to all plant lice, the woolly aphids subsist on the plant juices, feeding by means of piercing and sucking beaks. Wherever they feed, galls of greater or less size are produced, the exact reason for which is not fully understood. It is due probably to some poison injected by the insect into the tissue of the plants.

The galls formed on the soft root tissue are of large abnormal growths which soon commence to decay, their destruction being hastened by the entrance of fungi and bacteria. As the roots weaken and die, the aphids die also, or move to other roots, so that when looking for the first time for signs of woolly aphis, one may find badly injured roots from which the insects have all disappeared. By further search, live aphids may be discovered on the few live roots remaining, or close by the trees. The continual weakening and rotting of the infested roots is what renders woolly aphis damage so disastrous. The drain on the vitality of the tree soon results in a sickly dwarfed appearance of the root.

Nematode Root Gall or Root Knot

*The nematode is not an insect nor is it related to the insects. It belongs to the class of animals known as *vermes* or true worms. The common earth worm is the best known example of the class, although it occupies a position in a higher group than that of the nematodes. There are a good many species of nematodes, some living in the ground, some parasites on animals, and a few live parasitically on plants. Often in moist soil, rich in humus, such as vegetable gardens, there may be large numbers of white transparent worms. These are nematodes however, that do no appreciable injury to plants, and it is only the parasitic species of which this subject is an example.

The *Heterodera radicicola* is widely distributed over the world and attacks large varieties of plants. In the Argentine Republic it is said to be the most destructive pest of the vine occurring in that country. In the United States it is chiefly destructive in greenhouses.

This parasitic species is an exceedingly small worm-like creature about one-seventy-fifth of an inch long, and of a transparent whitish color. It has a sharp slender organ on the head that enables it to make its way into the more tender portions of the roots, where it embeds itself in the tissues. Here it develops and lays eggs, from which succeeding generations arise. These may scatter through the soil and attack other portions of the roots. It is not so much the direct drain upon the roots, however, that causes the

† California Experiment Station, Bulletin 218.

* North Carolina Experiment Station, Bulletin 206.

* H. J. Quayle, California Experiment Station Bulletin No. 192, 1907.

damage as it is the decay of the hypertrophied tissue due to irritation caused by the work of the worms. They make conditions favorable for the attack of wood rot fungi which hasten the decay.

*Schofield gives the following list of plants commonly attacked: Beets, carrots, celery, egg plant, lettuce, carnation, muskmelon, pumpkins, potatoes, salsify, squash, tomato, watermelon, clover, cow peas, rape, soy beans, catalpa, cherry, elm, peach. The following are subject to attacks of nematodes and although these plants are not in themselves liable to serious injury, they should not be planted on soil infested with it for fear of keeping the gall worm alive: Alfalfa, vetch, sweet clover, asparagus, cabbage, cauliflower, garden peas, horseradish, strawberries, kale, lima beans, onions, radishes, spinach, sweet potatoes.

The following plants are seldom, if ever, affected with them: Barley, oats, wheat, rye, corn, sorghum, milo, kaffir, timothy and redtop. At present no method is known to eradicate the pest from infested soils.

For METHODS OF CONTROL, see under *Potato Pests*.

Crown Gall of Alfalfa

†Galls and gall-like swellings appear on the main roots just at the surface of the ground and the plants die. The trouble is favored by excessive moisture in the soil and is caused by a fungus, *Urophlyctis alfalfae*. This new disease in California had not been reported anywhere else in this country at this writing (June, 1911).

Gall of Commerce

There is a form of gall called the "Gall of Commerce" which is a product of the gall fly (*Cynips*), which lays its eggs in the soft twigs of an oak in Western Asia and Eastern Europe. They are rich in tannin and are used in making ink, dyeing, tanning, etc.

Fungus Galls on Trees

Professor J. W. Toumey, formerly of the Arizona station, has shown that a warty growth is due to a microscopic vegetable organism—a slime mould fungus, which in the case of the parasite determined for Arizona soils has been named for that investigator, *Dendrophagus globosus*. There is evidence to show that when the trees are transplanted to the orchards, the galls continue to grow, forming ultimately large warts. When they girdle the trunk they interfere with the movement of the sap. Young trees often die of the disease. The galls of varying sizes affect the base of the trunk, the larger roots, and sometimes occur on the stem above the surface of the soil. Affected trees show signs of starvation, yellowish foliage and enfeebled growth.

*Insect Galls

What are commonly known as galls are vegetable excrescences and comprise all abnormal vegetable productions developed on plants by action of animals, more particularly by insects, whatever may be their form, bulk or situation.

For the larvae of these insects, the galls provide shelter and sustenance. The exciting cause of the undue or excessive growth in the case of the typical galls appears to be a minute quantity of some irritating fluid or virus secreted by the female insect and deposited with her egg in the puncture made by her ovipositor in the outside bark or foliaceous parts. This virus causes the rapid enlargement and subdivision of the cells affected by it so as to form the tissues of the gall. Oval or larval irritation also, without doubt, plays an important part in the formation of many galls.

A certain relation is necessary between the stimulus and the plant, as evidenced by the limitation in the majority of cases of each species of gall insect to some one vegetable structure, still, it must be a quality of the irritant of the tissues rather than the specific peculiarities on the part of the plant affected that principally determines the nature of the gall. Thus the characteristics of the currant gall, *Spathegaster baccarum*, which occurs alike on the leaves and on the flower

* Nevada Experiment Station Bulletin 91.
† Smith, California Experiment Station Bulletin 218.

* Encyclopedia Britannica, 11th edition.

stalks of the oak, are obviously due to the act of oviposition and not to the functions of the parts producing it. The red galls of the sawfly, *Nematus gallicola*, are found on four different species of willow.

Galls vary remarkably in size and shape according to the species of their makers. The *polythalamous gall*, found on the roots of old oak trees, may attain the size of a man's fist; the gall of another *Cynipid*, which occurs on the male flowers of oak, is two millimeters or barely a line in length. Many galls are brightly colored, as for instance, the oak-leaf hairy galls of *Spathegaster tricolor*, which are of a crimson hue.

The variety of forms of galls is very great. Some are like urns or cups, others are lenticular. Galls are formed by insects of several orders Among the *Hymenoptera* are the gall wasps (*Cynips* and their allies), which infect the various species of oak. They are small insects having straight antennae and a compressed, usually very short abdomen with the second or third segments greatly developed and the rest imbricated and concealing the partially coiled ovipositor. The transformations from the larval state are completed within the gall, out of which the perfect insect tunnels its way usually in autumn, though sometimes after hibernation.

Among the commoner galls are the oak apple or oak sponge, the currant or berry gall, "oak-spangles," generally reputed to be fungoid growths until the discovery of their true nature by Frederick Smith, and the succulent "cherry galls." Galls are formed by the *hemopterous* and *homopterous* insects.

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Smith. Crown Gall and Sarcoma. Bureau of Plant Industry Circular 85.

Mississippi Experiment Station Bulletin 147.

The following deal with Nematode Galls:

California Experiment Station Bulletin 192.

Nevada Experiment Station Bulletin 91.

Kentucky Experiment Station Bulletin 142.

Bureau of Plant Industry Bulletin 217.

GRANVILLE LOWTHER

GARDEN. See *Vegetable*.

Gardener's Calendar and Planting Table

Prepared for the Latitude of Medford, Oregon, by Mr. P. J. O'Gara.

This table will be found nearly correct for most sections in the Northwest with the exceptions noted below. It will be helpful in this connection to consult the frost tables in connection with each state for the length of the growing season in any section.

VEGETABLES	Seeds or plants required for 100 feet of row	PLANTING DISTANCES			Depth of planting	Planting time in the open (not in hotbed)	Time required to mature Ready for use
		DISTANCE BETWEEN ROWS		Distance between plants in row			
		Horse cultivation	Hand cultivation				
Artichoke, Globe	½ ounce	3 to 4 ft.	2 to 3 ft.	2 to 3 ft.	1 to 2 in.	Early spring	15 months
Artichoke, Jerusalem	2 qts. tubers	3 to 4 ft.	1 to 2 ft.	1 to 2 ft.	2 to 3 in.	Early spring	6 to 8 months
Asparagus, seed	1 ounce	2½ to 3 ft.	1 to 2 ft.	3 to 5 ft.	1 to 2 in.	Feb. to May	3 to 4 years
Asparagus, plants	60 to 80 plants	3 to 5 ft.	1 to 2 ft.	15 to 20 in.	3 to 5 in.	Dec. to March	1 to 3 years
Beans, bush	1 pint	2½ to 3 ft.	1½ to 2 ft.	5 to 8 ft.	1 to 2 in.	March to Aug.	40 to 65 days
Beans, pole	½ pint	3 to 4 ft.	3 to 4 ft.	3 to 4 ft.	1 to 2 in.	March to June	60 to 90 days
Beets	2 ounces	2 to 3 ft.	1 to 1½ ft.	2 to 3 in.	1 to 2 in.	March to Aug.	60 to 80 days
Brussels sprouts	¼ ounce	2½ to 3 ft.	2 to 2½ ft.	1½ to 2 ft.	½ in.	Feb. to Sept.	90 to 120 days
Cabbage, early	¼ ounce	2½ to 3 ft.	2 to 2½ ft.	1 to 1½ ft.	½ in.	Feb to April	90 to 150 days
Cabbage, late	¼ ounce	2½ to 3⅓ ft.	2 to 3 ft.	1⅓ to 2 ft.	½ in.	June to Aug.	90 to 150 days
Carrot...	1 ounce	2½ to 3 ft.	1½ to 2 ft.	2 to 3 in.	½ in.	Feb. to May	75 to 110 days
Cauliflower	¼ ounce	2½ to 3 ft.	2 to 2½ ft.	1 to 1½ ft.	½ in.	March to May	100 to 130 days
Celeriac.	¼ ounce	2½ to 3 ft.	1½ to 2 ft.	2 in.	½ in.	Feb. to April	100 to 150 days
Celery.	¼ ounce	3 to 6 ft.	1½ to 3 ft.	4 to 8 in.	½ in.	Feb. to May	120 to 160 days
Chervil, salad..	1 ounce	2½ to 3 ft.	1½ to 2 ft.	3 to 4 in.	1 in.	March	12 months
Chervil, turnip-rooted	1 ounce	2½ to 3 ft.	1½ to 2 ft.	2 to 3 in	1 in.	September	12 months
Citron.	1 ounce	8 to 10 ft.	8 to 10 ft.	8 to 10 in.	1 to 2 in.	April to May	100 to 130 days
Corn, sweet.	¼ pint	3 to 3½ ft.	2½ to 3 ft.	2½ to 3 ft.	1 to 2 in.	April 15 to May	60 to 100 days
Cress, upland	½ ounce	2½ ft.	1 to 1½ ft.	2 to 3 in.	½ to 1 in.	Feb. to April	30 to 40 days
Cress, water	½ ounce, or less	Broadcast in ditch	es carrying spring	water.		March to Sept	60 to 70 days
Cucumber.	½ ounce	4 to 6 ft.	4 to 6 ft.	4 to 6 ft.	1 to 2 in.	March 15 to June	60 to 80 days
Egg plant	⅓ ounce	2½ to 3 ft.	2 to 2½ ft.	1½ to 2 ft.	½ to 1 in.	March to April	100 to 140 days
Endive...	1 ounce	2½ ft.	1½ ft.	8 to 12 in.	½ to 1 in	March to April	90 to 180 days
Horseradish ..	70 roots	2½ to 3⅓ ft.	2 to 2½ ft.	14 to 20 in.	3 to 4 in.	Early spring	1 to 2 years
Kale, or borecole	¼ ounce	2½ to 3 ft.	1½ to 2 ft.	1½ to 2 ft.	½ to 1 in.	Feb. to Aug.	90 to 120 days
Kohl-rabi	¼ ounce	2½ to 3 ft.	1½ to 2 ft.	4 to 8 in.	½ to 1 in.	Feb to Aug.	60 to 80 days
Leek..	½ ounce	2½ to 3 ft.	1⅓ to 1⅔ ft.	4 to 8 in	1 in.	April to July	120 to 180 days
Lettuce.	½ ounce	2½ ft.	1 to 1½ ft.	4 to 6 in.	½ in.	April to Aug.	3 to 4 weeks
Martynia..	½ oz. for 100 hills	3 ft.	3 ft.	3 ft.	1 to 1½ in.	April to July	60 to 80 days
Melon, musk	½ ounce	6 to 8 ft.	6 to 8 ft.	Hills, 6 ft.	1 to 2 in.	March to May	100 to 120 days
Melon, water.	1 ounce	8 to 12 ft.	8 to 12 ft.	Hills, 10 ft.	1 to 2 in.	March to May	120 to 140 days

Gardener's Calendar and Planting Table—Continued

VEGETABLES	Seeds or plants required for 100 feet of row	PLANTING DISTANCES: DISTANCE BETWEEN ROWS		PLANTING DISTANCES: Distance between plants in row	Depth of planting	Planting time in the open (not in hotbed)	Time required to mature Ready for use
		Horse cultivation	Hand cultivation				
Okra, or gumbo	2 ounces	4 to 5 ft.	3 to 4 ft.	2 to 2½ ft.	1 to 2 in.	March to May	90 to 130 days
Onion, seed	1 ounce	2 to 3 ft.	1 to 1½ ft.	2 to 3 in.	½ to 1 in.	March to April	100 to 150 days
Onion, sets	1 quart	2 to 3 ft.	1 to 1½ ft.	2 to 3 in.	1 to 2 in.	October	90 to 120 days
Parsley	¼ ounce	2 to 3 ft.	1 to 1½ ft.	2 to 4 in.	¼ in.	All year round	90 to 120 days
Parsnip	½ ounce	2½ to 3 ft.	1½ to 2 ft.	2 to 2½ in.	½ to 1 in.	Feb. to May	125 to 160 days
Peas	1 to 2 pints	3 to 4 ft.	2½ to 3 ft.	1 in.	2 to 3 in.	Feb. to Aug.	40 to 80 days
Pepper	⅛ ounce	2½ to 3 ft.	1½ to 2 ft.	15 to 18 in.	½ in.	Feb. to May	100 to 140 days
Physalis or ground cherry	⅛ ounce	2½ to 3 ft.	1½ to 2 ft.	1½ to 2 ft.	½ in.	March to May	130 to 160 days
Potato, Irish	5 lbs. (9 bu. pr. acre)	2½ to 3 ft.	2 to 3 ft.	1⅛ to 1½ ft.	4 to 6 in.	Jan. to June 1st	80 to 140 days
Potato, sweet	3 lbs. (or 75 slips)	3 to 5 ft.	3 to 5 ft.	14 in.	3 to 4 in.	April 15 to June	140 to 160 days
Pumpkin	½ ounce	8 to 12 ft.	8 to 12 ft.	Hills, 8 to 12	1 to 2 in.	April to June	100 to 140 days
Radish	1 ounce	2 to 3 ft.	1 to 1½ ft.	1 to 1⅛ in.	½ to 1 in.	Feb. to Sept.	20 to 40 days
Rhubarb, seed	½ ounce	3 ft.	2½ to 3 ft.	6 to 8 in.	½ to 1 in.	Early spring	2 to 4 years
Rhubarb, plants	33 plants	3 to 5 ft.	3 to 5 ft.	3 ft.	2 to 3 in.	Autumn or early spring	1 to 3 years
Rutabaga	¼ ounce	2½ to 3 ft.	1½ to 2 ft.	6 to 8 in.	½ to 1 in.	Feb. to July	60 to 80 days
Salsify	1 ounce	2½ to 3 ft.	1½ to 2 ft.	2 to 4 in.	½ to 1 in.	Feb. to May	120 to 160 days
Spinach	1 ounce	2½ to 3 ft.	1 to 1½ ft.	1½ to 2 in.	1 to 2 in.	Sept. to Feb.	30 to 60 days
Squash, summer	½ ounce	3 to 4 ft.	3 to 4 ft.	Hills, 3 to 4 ft.	1 to 2 in.	April to June	50 to 80 days
Squash, late	½ ounce	7 to 10 ft.	7 to 10 ft.	Hills, 7 to 9 ft.	1 to 2 in.	April to June	115 to 140 days
Swiss chard	¼ ounce	2½ to 3 ft.	1½ to 2 ft.	1½ to 2 ft.	½ to 1 in.	Feb. to Aug.	90 to 120 days
Tomato	⅛ ounce	3 to 5 ft.	3 to 4 ft.	3 ft.	½ to 1 in.	May to June	100 to 140 days
Turnip	½ ounce	2 to 3 ft.	1½ to 2 ft.	2 in.	¼ to ½ in.	Feb. to July	60 to 80 days
Vegetable marrow	½ ounce	8 to 12 ft.	8 to 12 ft.	Hills, 8 to 9 ft.	1 to 2 in.	March to May	110 to 140 days

D. S. Stanley, at Weiser, Idaho, reports that the growing season for garden crops will vary from the Medford, Ore. season from a week to 30 days at each end, the Weiser season being for the most part later and shorter, but crops will mature much quicker so that so long a growing season is not needed.

Roseburg Nursery Co., Roseburg, Ore., reports that many of the hardy crops listed may be planted as early as midwinter. The time to mature the crops is about the same.

Prof. O. M. Morris, at Pullman, Wash., reports that the season for early vegetables will be a month to six weeks later than Medford and crops mature in about the same period, though the growing season is not so long.

In this the dates were considered for the upland regions of Eastern Washington. The Snake river sections could, in practically every case with early vegetables, plant about one month earlier, and in the case of late planting the work could be done about one month later and still give the plants time to mature.

Irrigation will not be necessary with any of the crops mentioned, but sufficient temperature will not be attained to grow such crops as watermelons, peppers, egg plant and tomatoes successfully on a large scale.

Garden Slug. See *Radish Pests.*

Georgia

On account of its altitudes and latitudes, its mountains, hills and valleys, Georgia produces the kinds of crops grown in every state in the Union. On its seacoast and islands in the southeastern portion, it produces oranges, lemons and bananas; in its higher elevations, it produces small fruits, pears, peaches, plums and apples. It has greater resources than are found in any of the Southern states east of the Rocky mountain range. Its climate, soil, timber, coal, minerals and marble are all natural advantages, while its navigable rivers and railroad lines give it better transportation than is available to most Southern states, and tend to make it a section of great possible development.

The eastern portion of the state was once a part of the bed of the Atlantic ocean. This is shown by the Tertiary and Metamorphic rocks which cover a large portion of the state. The soil in the lowlands and valleys is alluvial. In the Cumberland plateau and the Great valley regions there are red and brown loams, rich in decomposed limestone, calcareous shales and sandy or gravel formations.

In the Piedmont plateau and Appalachian mountain regions the surface is generally sandy, but in considerable areas the subsoil is a red clay, derived largely from the decomposition of hornblende.

For horticultural purposes, the state has been divided into four parts as follows:

First: The fig and citrus belt, in what is known as the Quatenary formation.

Second. The pear and melon belt, in what is known as the Tertiary formation.

Third. The peach and grape belt, in the Metamorphic formation.

Fourth. The apple and the cherry belt, in the Tennessee Dip.

It is interesting to know why these fruits thrive in the sections designated. Why is the apple, for instance, adapted to the Tennessee Dip, and not to the sections occupied by the Quaternary or Tertiary formations? Soil conditions have something to do in determining this question; but the principal reason is found in the climate.

In another connection we have shown how, in a mountainous country, great changes occur in short distances, on account of elevation. That which is true in a general way is true in Georgia. Other conditions enter into it, such as wind currents, and relations to large bodies of water, so that the climate of Georgia is perhaps as variant as that of any other state in the Union. There are nine climatic belts in the United States and all of them are represented

in Georgia, except that of Southern Florida.

The average rainfall for the whole state is 49.3 inches. The maximum rainfall at Rabun gap, in the extreme northeast part of the state, is 71.7 inches. The minimum rainfall is at Swainboro, Emanuel county, a little southeast of the center, 39.4 inches.

The Quaternary represents the Pleistocene, or glacial age. It represents the formation of soils in an age when glaciers, some of them miles in extent, advanced and retreated across the American continent and Northwestern Europe, carrying rocks, soil, trees and other vegetation; crushing, grinding, eroding and pulverizing everything in their track. During this period, Arctic types of plants and animals were forced southward, and during the retreats other forms, grown in the south, were carried toward the north. It is not because the soil thus formed is not favorable for the growth of apples, but because this Quaternary or glacial drift in Georgia is found in a climate that is almost tropical, and therefore adapted to oranges, lemons and bananas, rather than to the growth of deciduous fruits. As compared with the whole state, this citrus belt is small.

The Tertiary formation is the third leading division of sedimentary and fossiliferous rocks, formed in the bottoms of the lakes, bays, estuaries and inland seas. These basins were uplifted by the cooling and shrinking of the earth, and consequent changes in its crust, and became rocky hills, which eroded and disintegrated, forming soil. This soil is especially adapted to melons and pears. Here, also, sweet potatoes, yams, pumpkins and other vegetables reach a high state of perfection. This section includes more than half the whole area of the state of Georgia.

The Metamorphic formation is mostly limestone, clay, slate, schist, mica, quartz, etc., laid down by the action of the water, and then transformed by the heat, by chemical agency, pressure or by all of these combined. This formation in Georgia has been lifted to a higher elevation than the Tertiary, and is the home of the peach and the grape. It is a red clay and will grow a very high grade of grapes and peaches; yet peaches are not grown so extensively here, in this Metamorphic formation, which is mostly a red clay, as in the Tertiary. This is probably due to the fact that the Metamorphic formation is farther from the navigable rivers, bays and main lines of railroad than the other sections, and therefore farther from the markets.

The so-called Tennessee Dip is a lower stratum of rock, therefore an older formation than the Metamorphic and the Tertiary. Yet, though it was lower and older, in the process of upheavals it was thrown to the surface, and now occupies a higher elevation than the later formations. It is generally known as the Cambrian layer, composed of a thick series of slate, schists, sandstones and conglomerates, together with igneous rocks. These are the formations that when eroded and disintegrated compose the basis for the soils of the Tennessee Dip, called the apple belt. This is not to signify that apples do equally well in all the sections of the Tennessee Dip, but that in the coves of the hills and mountains, where there is good air drainage and protection from winds, they reach a high state of perfection. This region is the northwestern portion of Georgia; the citrus belt is the southeastern; and the pear, peach, melon and grape belts lie between these extremes. During the decade 1890 to 1900, the area devoted to peaches was doubled.

GRANVILLE LOWTHER

STATION	FROST				Precipitation
	Average Date of		Date of		Annual
	First Killing in Autumn	Last Killing in Spring	Earliest Killing in Autumn	Latest Killing in Spring	Inches
Clayton	Oct. 21	April 15	Oct. 1	April 24	68.5
Adairsville	Oct. 31	April 3	Oct. 15	April 24	47.6
Dahlonega	Nov. 4	Mar. 31	Oct. 15	April 24	59.9
Elberton	Nov. 8	Mar. 29	Oct. 25	April 7	50.0
Atlanta	Nov. 7	Mar. 24	Sept. 27	April 10	49.9
Covington	Nov. 9	Mar. 31	Oct. 25	April 11	50.7
Augusta	Nov. 9	Mar. 18	Oct. 8	April 16	48.5
Harrison	Nov. 12	Mar. 20	Oct. 25	April 1	51.4
Talbatton	Nov. 12	Mar. 23	Oct. 25	April 10	51.7
Dudley	Nov. 11	Mar. 20	Oct. 23	April 8	50.1
Savannah	Nov. 27	Feb. 26	Nov. 1	April 5	51.0
Lumpkin	Nov. 11	Mar. 11	Oct. 25	Mar. 31	50.5
Morgan	Nov. 13	Mar. 10	Oct. 21	April 8	50.6
Poulan	Nov. 13	Mar. 11	Oct. 25	Mar. 28	50.9
Jesup	Nov. 20	Mar. 17	Nov. 4	April 11	57.0
Waycross	Nov. 18	Mar. 13	Nov. 4	April 8	50.8
Thomasville	Nov. 21	Mar. 2	Nov. 8	Mar. 19	53.8

Southern Georgia

For Bloom Periods of Apples, see *Louisiana.*

Gingko

A tree much prized by the Chinese and Japanese, sometimes regarded as a sacred tree and planted near their temples. It belongs to the genus *Salisburia* of the yew group of conifers. Its fruit, which grows to about the size of the American plum, has a disagreeable odor, enclosing a seed that when roasted tastes something like maize or Indian corn. It is of no commercial value in this country. The tree is a graceful, stately grower, and is sometimes planted in Europe for ornamental purposes.

Granville Lowther

Gooseberry

The gooseberry is of the genus *Ribes*, natural order *Saxifragaceae.* This fruit is native to the Northern hemisphere, and grows wild in many parts of North America, especially the Eastern and Middle United States.

There are about a half dozen species cultivated in Europe, some of them for their fruits, and some for their flowers. Some of the European varieties grow to enormous size, weighing nearly two ounces per berry; but these are not the best for their fruits and have not proven to be successful on the American continent on account of their tendency to mildew. Also the skin is tough and they are very sour.

History of American Gooseberry

The history of the American gooseberry with notes on culture is given by Dr. Wm. Saunders, of the Dominion Experiment Station, as follows:

"As late as 1846 no cultivated varieties of American species of gooseberries were mentioned by writers, the first reference, according to Bailey, being in 1849 in the Northern Fruit Culturist, by Goodrich, where the author writes: 'We have it from good authority that native sorts have been discovered both in New Hampshire and Vermont well adapted to garden culture.' In 1847 the Houghton's Seedling was exhibited at a meeting of the Massachusetts Horticultural Society, this being the first improved form of the native gooseberry of which there is a record.

"There is a good field for work in improving the native gooseberries, as there is no apparent reason why the size should not be equal to the best English varieties. The quality of the American varieties is considered by some to be better than the average English gooseberry, but the flavor is not nearly as good as the best of the English sorts.

Propagation

"Gooseberries may be propagated either from cuttings or by layering. The average person will usually get the best results from layering, as cuttings are often very unsatisfactory. To propagate by layering, the bushes should be pruned severely in the autumn. This will induce a strong growth of young wood the next season. When these have made most of

English Varieties of Gooseberries—Columbus, Chautauqua and Red Jacket—recommended by F. W. Rane for New England.
(New Hampshire Experiment Station.)

their growth, which will be early in July, the earth is heaped up around and through the bush until only the tips of the young shoots are left uncovered. The soil is packed down and then a covering of loose soil thrown over to retain moisture better. Most of the American varieties will have rooted well by autumn, and the young plants may be detached and planted in nursery rows either the same fall or the following spring, to be grown there for one season. English varieties usually take two years to root, and the soil must be left about the bushes for that time. Cuttings of American varieties will sometimes give fairly satisfactory results if made from well ripened wood and treated as currant cuttings. The cuttings are made six to eight inches or less in length, and buried in soil over winter. In spring they are set out in nursery rows, planting deep enough so that only one or two buds are above ground. Both American and English varieties may be propagated from green wood cuttings in a greenhouse, or hotbed with bottom heat.

Soil, Planting and Culture

"The gooseberry is a moisture-loving plant, hence a soil should be chosen where there will be a constant supply of water during the growing season. In dry soils gooseberries suffer very much in a dry time, the foliage often falling prematurely and the fruit being scalded by the sun. The soil should be a cool one. Moist soils are usually this, but the surface of a sandy loam soil gets very hot in the summer, hence is not the best for this fruit. Well drained, heavy clay loams are the most suitable for gooseberries, as these usually are both cool and moist. The soil should have abundant plant food easily made available. A good application of well rotted manure thoroughly worked into the soil will do much to bring about these favorable conditions. The soil should be well prepared and made mellow as for a crop of roots. As gooseberries start to grow early in the spring it is usually preferable to plant in the autumn, and as the leaves drop early they may be planted in September and will be in good condition when winter comes. Well rooted cuttings or layers may be used as plants. They should be set in rows about six feet apart and four feet apart in the rows.

"Cultivation should be very thorough so as to retain moisture and keep the soil cool, and as the gooseberry roots near the surface cultivation should be shallow;

mulching with straw is sometimes advisable to keep the soil cool.

"As the gooseberry makes much more wood than it is desirable to leave, severe pruning is necessary. English varieties are usually trained to a single stem, but this is not necessary, although the freer circulation of air when trained in this way may help to prevent the spread of mildew The usual custom in America is to grow the gooseberry in bush form. The bush should at first be brought into a good shape by leaving a few of the strongest shoots regularly distributed to make an open head. Five or six of these shoots are quite sufficient to leave at first. As the bush gets older, new shoots are allowed to grow to take the place of the older ones, as the pruning should be done with a view to having only vigorous bearing wood. Fruit is borne on year-old wood and from spurs on older wood It usually is not desirable to have any wood more than three years old The best time to prune is in the autumn or winter. The weakest young shoots should be cut off at the ground, also all the stronger young shoots not required for fruiting or to take the place of the older branches to be cut away. The side shoots from the older branches should be headed back or cut out altogether so as to maintain a fairly open head, making it as easy as possible to pick the fruit and yet leaving sufficient wood to produce a good crop and to shade the fruit from the sun, as in a hot, dry time gooseberries are liable to be injured by scalding. When branches are more than three years of age they should be removed to make way for younger wood. It is advisable to cut out all branches which touch the ground as there will then be a better circulation of air, and the fruit will be kept off the ground. Gooseberries will often begin to bear the second year after planting, but there will not be a full crop until the fourth season. If the soil is kept in good condition by an annual application of well rotted barnyard manure in the autumn, harrowed in the following spring, and if the bushes are kept sprayed and well pruned, the plantation will not need to be renewed for many years."

Varieties

The list of American gooseberries recommended by Card, is as follows:

Apex, Champion, Downing, Excelsior, Houghton, Hudson, Jewitt, Orange, Pale Red, Pearl, Red Jacket, Smith, Strubler, Tree, Victoria

Hybrids or Unclassified Varieties

Cedar Hill, Crystal, Hale Golden, Mountain, Newell Seedling, Orange Jumbo, Stein.

English Gooseberries

Blucher, Chautauqua, Columbus, Crown Bob, Dominion, Excellent, Frontenac, Industry, Jolly Angler, Keepsake, Lady Popham, Lancashire Lad, Leveler, Lord Beaconsfield, Matchless, Portage, Puyallup, Queen of the Whites, Red Champagne, Red Jacket, Red Warrington, Smiling Beauty, Spineless, Stockwell, Success, Sulphur, Sunset, Tally Ho, Thumper, Triumph, Wellington Glory, White Eagle, White Smith.

Originated by Dr. Wm. Saunders

Perhaps no American has done so much to improve the gooseberry as Dr. Wm. Saunders, of the Dominion Experiment farm, Canada. The following varieties are due to his patient toil and intelligence, as the best of his productions:

Deacon, Richland, Mabel, Duncan, Alma, Pearle, Flora, Silvia, Ralph, Red Jacket, Gibb, Rideau, Ruth, Saunders.

Recommended by the American Pomological Society

Recommended by the American Pomological Society for the United States and Canada:

*District No. 1

Successful: Industry, White Smith, Josselyn, Smith.

Very successful: Downing, Houghton, Pearl.

Recommended for trial: Columbus, Keepsake.

District No. 2

Successful: Chautauqua, Columbus, Crown Bob, Industry, Wellington, White

* See Page 192.

Gooseberries.

1—Golden Prolific, a large English variety, green in color, turning yellow when ripe; quality excellent. 2—Keepsake, much like the Golden Prolific but does not bear as heavily. 3—Industry, another English variety turning dark red when ripe; quality excellent. 4—Chautauqua, a variety much like the Golden Prolific but of a lighter color. 5—White Smith, an English variety, medium to large, and of good quality when ripe. 6—Lancashire Lad, resembling the Chautauqua but not as prolific. 7—Pearl, medium in size, midway between the English and American types, very prolific and an excellent berry. 8—Portage, large, dark red, spiny, of good quality. 9—Josselyn, medium in size, red when ripe, of good quality, very prolific. 10—Houghton, small, prolific, of good quality; its chief objection is its size. Oregon Champion Gooseberry is not in this list, but is one of the best varieties for Western Washington.

—Photo and Descriptions by J. H. Stahl, Western Washington Experiment Station.

Smith, Champion, Houghton, Pearl Red, Pearl, Smith.

VERY SUCCESSFUL: Josselyn, Downing.

District No. 3

SUCCESSFUL: Chautauqua, Columbus, Crown Bob, Champion, Downing, Houghton, Smith.

District No. 4

SUCCESSFUL: Industry, Josselyn, Pale Red, Smith.

VERY SUCCESSFUL: Downing, Houghton.

Districts Nos. 5, 6 and 7

Are not suited to the growing of gooseberries, therefore none is recommended. These districts include Florida, parts of Georgia, North and South Carolina, and the states westward to Texas on the Gulf of Mexico.

District No. 8

SUCCESSFUL: Crown Bob, Champion, Pale Red, Pearl, Smith.

VERY SUCCESSFUL: Downing, Houghton.

RECOMMENDED FOR TRIAL: Chautauqua, Columbus, Industry, Wellington, Carrie, Competine, Craighead.

District No. 9

SUCCESSFUL: Chautauqua, Columbus, Crown Bob, Industry, Wellington, Carrie, Champion, Josselyn.

VERY SUCCESSFUL: Downing, Houghton, Pearl.

RECOMMENDED FOR TRIAL: Competine, Mathews, Smith.

District No. 10

SUCCESSFUL: Chautauqua, Columbus, Industry, Champion, Houghton, Pearl, Poorman, Smith.

VERY SUCCESSFUL: Downing.

District No. 11

None is recommended for this district, as it includes a part of Texas, with the Pecos and Rio Grande rivers as dominant features. Gooseberries do not succeed in this section.

District No. 12

SUCCESSFUL: Berkeley, Chautauqua, Industry, White Smith, Champion, Oregon.

VERY SUCCESSFUL: Downing, Houghton, Josselyn, Smith.

RECOMMENDED FOR TRIAL: Pearl Red, Pearl.

District No. 13

RECOMMENDED AS SUCCESSFUL Downing, Pearl, Smith.

VERY SUCCESSFUL: Industry, Houghton.

District No. 14

SUCCESSFUL· Downing.

VERY SUCCESSFUL: Champion.

RECOMMENDED FOR TRIAL: Industry.

District No. 15

SUCCESSFUL: Industry, Downing.

VERY SUCCESSFUL: Champion.

Districts 16, 17 and 18

Include California and Arizona, and none is recommended for these districts.

A study of these recommendations will show that the Downing and the Houghton are more generally recommended as very successful than any other varieties.

For VARIETIES GROWN IN ALASKA, see *Alaska*.

GOOSEBERRY DISEASES

LEAF SPOT. See *Currant Diseases*.

Powdery Mildew

This is the most serious fungus disease which is known to attack the foliage and fruit of the gooseberry. It is a native disease; that is, due to a fungus which doubtless occurred upon wild gooseberries before cultivated varieties were planted in this country. It is found to be much more serious upon European varieties than American varieties. It is probable that varieties originating from European species, not having this fungus to contend with, have never developed any natural immunity. This disease is present in more or less severity in all parts of the United States where gooseberries are grown.

Symptoms

This disease is characterized by the production of a superficial white mold or mildew in spots on the fruit and foliage of young canes. It probably first starts upon the young foliage, but is first noticed by the grower upon the fruit. The spots are at first whitish but later become buff or almost brown in color. From the fruit the disease spreads rapidly to the foliage and young canes. If examined with a pocket lens the spots, when young, are seen to consist of a

white cob-webby growth. Several spots may grow together and large patches may be formed. In older spots the moldy growth turns brown. Later in the year small black specks, just visible to the unaided eye, appear in the brown mold in older spots.

The berries, when attacked on one side, may develop unevenly, and in severe cases may crack and decay. When attacked at a later stage they do not crack; but the presence of the mold renders them unsalable.

The leaves of diseased shoots are small and where badly affected gradually turn brown. The general effect on the plant is to reduce the vitality and market value of the crop.

Cause

This disease is caused by a fungus belonging to a group known commonly as the powdery mildews. These fungi are superficial in their growth; that is, the mycelium develops largely on the outside of the affected spots instead of in the tissues as is the case with most fungi. The mycelium sends short branches into the outer cells of the part of the plant attacked. These absorb the sap. In the early part of the season the summer spores are produced in chains on the erect branches of the mycelium. These are produced in great abundance and soon fall apart, giving the surface of the spots a dusty appearance, from which fact the name "powdery mildew" has originated. These spores are easily spread by the wind or other agencies and start new spots wherever they come to rest. This superficial mycelium, as noted above, soon turns dark and becomes thick-walled, and later in the season black spherical receptacles are formed which have long thread-like appendages attached. These are called perithecia; they are hollow and enclose a single large sack or ascus, inside of which are found eight rather large spores. This stage, which may be referred to as the winter spore stage, serves to carry the fungus over winter. The perithecia, when mature in the spring, burst, forcibly ejecting the spores, which, on coming to rest upon young leaves or fruit, germinate, causing the first spots. It is thus seen that the fungus, which remains over the winter on the canes of the current growth and on the leaves and ground, etc., serves as a source of infection in the spring.

Treatment

This disease is one of the most difficult among the powdery mildews to control. The standard remedy for years has been to spray with potassium sulphide, 1 ounce to 2 or 3 gallons of water, beginning when the buds break open and continuing at intervals of ten days until about seven applications have been made. This, wherever used thoroughly, has been found to control mildew.

Co-operative experiments conducted by the writer in Oregon during the past season indicate that an application of winter strength lime-sulphur to the dormant branches, followed by applications of lime-sulphur diluted 1-30 on the foliage at frequent intervals, gives excellent satisfaction. On account of the slight deposit of lime-sulphur it may be found desirable to use potassium sulphide in the later sprayings.

H. S. JACKSON

RUST. See *Currant Diseases.*

For other DISEASES OF GOOSEBERRY, see under *Currant Diseases*

GOOSEBERRY PESTS

FRUIT WORM. See *Currant Pests.*

Gooseberry Fruit Worm

Zophobia grossulariae Riley

Just before gooseberries ripen, clusters of two or three may sometimes be noticed which are prematurely colored and which are joined together by the webs spun by the caterpillar or a small moth. These caterpillars are pale greenish-white and sometimes have a reddish tinge. They live inside the berries and, when the contents of one berry are consumed, attack another near at hand, joining it to the first by a silken web. When full grown they fall to the ground and spin brown parchment-like cocoons, just beneath the surface of the ground. The moths, which are pale grey, marked with dark streaks and bands, are very rarely

observed. They fly early in spring, and there is only one brood in the year.

Remedy

The best method of controlling this insect, which fortunately is never very abundant, is to pick by hand the clusters of injured berries. It is claimed that chickens and other poultry are useful in destroying the larvae and chrysalids; and it is certain that, while chickens are very small, they are useful in a garden in destroying a great number of injurious insects. The old hen, however, should be kept securely cooped up and not allowed to run at large.

JAMES FLETCHER,
Dominion Entomologist, Ottawa, Can

Gooseberry Midge

Cecidomyia grossulariae

This is a small, yellowish fly, about one-tenth of an inch long, which deposits its eggs beneath the skin of the young fruit. Remedy, hand-picking and destruction of the infested berries.

Mealy Flata or Frosted Lightning Hopper

Ormenis pruinosa

This insect is sometimes found on gooseberry as well as grape, sassafras, corn and other plants. It is a lead-colored or pale green, wedge-shaped insect, frosted over with a whitish bloom, and has its wings lying flat against its sides and prolonged behind the body to meet each other. It is a sucking insect. No remedy is needed. The eggs are laid in twigs of sassafras and other trees in a continuous raised slit, sometimes in September or soon thereafter.

OYSTER SHELL SCALE. See *Apple Pests*.
SCALE INSECTS. See *Apple Pests*.
For other PESTS OF GOOSEBERRY, see *Currant Pests*.

Gourd

The gourd belongs to the order *Cucurbitaceae* and includes the following:

First: The calabash, or bottle-gourd, having a hard rind and club shaped, technically called *Lagenaria Vulgaris*.

Second: Squash; any one of the trailing annuals of the genus *Cucurbita*.

Third: Pumpkin; the large round fruit of the genus *Cucurbita pepo*.

Fourth: Muskmelon; *Cucumis melo*.

Fifth: Watermelon; *Citrullis vulgaris*.

Sixth: Cucumber; *Cucumis sativus*.

For CULTURE, see *Squash*, *Cucumber*, etc.
GRAFTING. See *Propagation* under *Apple*.
GRAIN APHIS. See *Aphids*.
GRAIN. See *Apple Orchard Cover Crops*.

Grapes

The subject may be divided into two parts. First, "Grapes of the Old World," second, "Grapes of America."

Grapes of the Old World

There is just one species of grape cultivated in the Old World, and that is *Vitis vinifera*. This is the grape of ancient and modern agriculture, renowned in history, fable, myth, allegory, and poetry. Orientals believed that it was planted in the Garden of Eden, to be cared for by our first parents. Milton says: "They led the vine to wed his elm." It seems pretty clear that the Canaanites grew large vineyards and grapes of very fine quality, at the time of the conquest of that country by the Israelites upon their return from Egypt, as early as 1500 years before Christ. The history of the grape dates back to the oldest historic times and has followed civilization into all parts of the world. In fact, seeds of the grape are found in the remains of the Swiss lake dwellings of the Bronze Period and entombed with the mummies of Egypt. Virgil gives fifteen varieties of grapes, while Pliny gives ninety-one varieties, and describes fifty kinds of wine.

From the "Grapes of New York" we quote the following:

"The history of the development of the vine from Virgil's time through the early centuries of the Christian Era and of the Middle Ages to our own day is largely the history of agriculture, in the Southern European countries, for the vine during this period has been the chief plant cultivated by the Greek and the Latin nations.

Characteristics of the European and American Grapes

"The Old World grape is grown for wine; the American grape for the table The differences arise largely out of the purposes for which they are grown. The *Vitis vinifera* varieties have a higher sugar and solid content than do those of America. Because of this richness in sugar, they not only make better wine, but keep longer and can be manufactured into raisins. The American grapes are not good keepers, and do not make good raisins. Taken as a whole, the European varieties are better flavored, have a more agreeable aroma, and lack the acidity and what some call the 'foxy odor' of the American grape. It is true that in some of the varieties there is a disagreeable astringency and that many are practically without flavor; yet, all in all, that species produces by far the better flavored fruit. On the other hand, American table grapes are more refreshing, and the unfermented juice makes a much more pleasant and refreshing drink. The bunches and berries of the European grape are larger, more attractive in appearance, and are borne in greater quantity vine for vine and acre for acre than the American grape. The pulp and skin of the *Vitis vinifera* are less objectionable than those of the native species, and the pulp separates more easily from the seeds. The berries do not shell from the stem nearly so quickly, hence the bunches ship better. In comparing the vines, those of the Old World grapes are more compact in habit, make a shorter and stouter annual growth, therefore require less pruning and training. The roots are fleshy and more fibrous. Taken as a whole, the species is adapted to more kinds of soil, and to greater differences in environment, also is more easily propagated from cuttings than the American grapes. The cultivated forms of the wild vines in this country have few points of superiority over their relatives from the Eastern hemisphere; but these few are such as to make them now and probably ever the only grapes to be cultivated in the commercial vineyards east of the Rocky mountains. Indeed, had it not been for the discovery that the vine of the *Vitis vinifera* could be grown on the roots of any one of the several species of the American grapes, the vineyards of the Old World grape would have been almost wholly destroyed within the last half century because of one of its weaknesses. This weakness is its non-resistance to the *phylloxera*, a tiny plant louse working on the leaf and root of the grape, which in a few years wholly destroys the European vine, but does comparatively little harm to the American vine. Three other pests are much more harmful to the European than to the American vines; these are black rot, downy mildew and powdery mildew.

"The susceptibility of the European grape to these parasites debars it from cultivation in Eastern America so effectively that there is but little hope of any pure-bred variety ever being grown in that region. However, by combining the good qualities of the foreign grape with those of the American grape, and by careful selection and breeding, we may in time secure varieties in all respects equal or superior to those of the Old World.

"Doubtless the quality of resistance to various diseases which belongs to the American grape is due to natural selection, resulting from the war which has been waged for ages between host and parasite, and the fact that they have been able to survive is a guarantee that they will perpetuate their powers of resistance.

"In the western part of the American continent European grapes have succeeded. At the old missions in New Mexico, Arizona and California, grapes of the European varieties were grown before settlements were made in the eastern parts of the United States. Great efforts were made by the Eastern colonists to grow European grapes and manufacture wine as an article of commerce. Several of the legislatures gave subsidies to French and German experts to establish successful and profitable vineyards; but after more than one hundred years of

Exhibit of European Grapes at the Washington State Fair, North Yakima, Wash.

failure, the project was abandoned. Since then, many attempts have been made but they have not proved successful. There have been practically three hundred years of failure to grow European grapes along the Atlantic coast and it has always proven that unless the varieties are improved or become better adapted, they cannot be made profitable.

The American Grape

"The American grape is pre-eminently a North American plant. There are about fifty species of the genus *Vitis*, more than half of which are found on this continent. But few other plants in America or in the world are adapted to such varied climate and soil conditions. In North America, wild grapes abound on the warm, dry soils of New Brunswick and New England, about the Great Lakes in Canada and the United States, and almost anywhere in the valleys and rich woodlands of the Southern states. They thrive in the dry woods, sandy sea plains and reef keys of the Carolinas, Georgia and Florida, where the vines of the Scuppernong often run more than a hundred feet over trees and shrubs, rioting in natural luxuriance. They flourish in the mountains and limestone hills of the Virginias, Tennessee and Kentucky. They are not so common in the West, yet they are found in almost all parts of the Mississippi valley, from the Great Lakes to the Gulf of Mexico. Even in the Rocky mountain and Pacific coast states, in semi-arid plains and mountains, grapes are found growing wild. It is certain that these wild grapes were not distributed over these regions by the hand of man. They have doubtless been growing in this region from before the time of the migration of the first savages. The agents for their distribution were birds, which carried the seeds; animals, lake and river currents. When the seeds were dropped, they entered the competitive struggle for existence with other plants, and succeeded. But climate, soil and other conditions of environment tended to modify them. The species found in the forests have tended to develop long, slender trunks and branches in their struggle to obtain sunlight and air. On the dry sands, or among the rocks, they are short and stubby. Still another form runs on the ground. One is almost evergreen, while nearly all others drop their leaves. Some are long-lived, growing and bearing fruit for nearly two centuries; while others are scarcely longer-lived than the ordinary shrub. Some have enormous stems a foot or more in diameter, others are slender and graceful. Not less remarkable than the differences in structure is the adaptability of the genus and some of the species to varied climatic conditions. Several of the wild grapes develop full size and display natural luxuriance and fruit-bearing qualities only in the Middle states, but may be found on the dry, gravelly, wind-swept hills far to the north or in some hot and humid atmosphere of the South, as if to show indifference to wet or dry, heat or cold.

"On the other hand there are many strong points of resemblance between the score or more of species. The organs and characters that do not bear the strain of changed environment nor suffer in the perpetual warfare with nature, are much the same in all the species of the *Vitis*. Thus, the structure of fruits, flowers and seeds is practically identical All have naked tipped tendrils; leaves and leaf buds are very similar, and various species usually hybridize freely. They are alike in the unlikeness of individual plants in any of the species; that is, all of the individuals of the genus are most variable, and the seeds taken from the same vine may produce plants quite unlike one another and quite unlike the parent. These few facts regarding the evolution and distribution of American grapes lead to two important conclusions:

"First, the species are so distributed throughout the United States, and individuals of the species grow in such luxuriance and abundance, as to suggest that we may be able to improve and domesticate some one or more of them for all the agricultural regions of the country. For it is proved that nearly all the wild grapes have agricultural possibilities; and experience with many plants teaches

A Yakima Valley Vineyard.

that the boundaries of areas inhabited by the wild species of a given region coincide with those suited to the production of the domesticated plant in that region. It is not possible to tell where the grape-growing regions of the future are to be located; for species and individuals of that fruit are so common that no one can say where the grape in America is most at home.

"Second, grapes are so variable and plastic in their nature that they yield readily to improvement. Besides being variable, they hybridize freely and thus the plant breeder can obtain valuable starting points. There are indications that some of the characters of the grapes follow Mendel's law of 'the inheritance by the offspring of the dominant traits,' and when once these have been determined, and the more important unit characters segregated and defined, it ought to be possible to rearrange and combine the characters of this fruit with some system, and surely with more certainty than in the past."

GRANVILLE LOWTHER

Propagation

The Scuppernong grapes of the South are almost exclusively increased by means of layerage. For this purpose the vine is pulled down in spring and covered with soil at intervals of two feet. Another method now in common use is to lay the new canes in shallow trenches in early spring and cover only two or three inches deep. When each node has thrown up a shoot a foot long earth is piled in about them, when they will take root. If the vine be slightly twisted or otherwise bruised at the points where covered, they will readily take root and form strong plants during the season. Late in fall or the following spring, the vine may be cut into sections, each part having roots being a separate plant.

Nearly all of the many scores of varieties root readily from cuttings. Grape cuttings should be made in early winter before there has been a hard freeze, from wood of the last season's growth. Vines with the joints close together make better cuttings than those having the joints far apart. Begin at the butt end of the vine, cutting it off squarely just below a joint or node. Counting this joint one, skip two more joints and cut the vine off at least two inches above the third one. It is best to have at least three joints for each cutting, although it is not absolutely

necessary to have more than two. The cuttings will range in length from 10 to 14 inches, although the majority are usually about 12 inches long.

Pack the cuttings in bundles of fifty each and store in green sawdust in a cool cellar until spring. The ground on which grape cuttings are to be planted should be moderately rich and plowed very deeply, preferably the fall before they are planted. The cuttings should be planted out early in April, care being taken to see that their buds have not begun to push out while packed in the sawdust. In the nursery the rows should be four feet apart and perfectly straight, being lined up with a wire or garden line. The cuttings may be planted by making holes about four inches apart, like planting apple grafts, or a furrow from eight to ten inches deep may be made. In either case, the cuttings should not stand up straight, but should lean toward the south, and the soil be packed very firmly around the bottom joint; only the top bud should be left above ground and the soil should be almost up to it.

The cuttings will often strike root from both the joints under ground, thus making very strong plants. They should grow in nursery rows for one, or preferably, two years, when they are ready to be moved to the permanent planting. The vineyard rows should be from eight to ten feet apart and the vines from six to eight feet apart in the rows. At the time of planting the vines should be cut back, leaving only about two buds to each branch.

Old grape vines are sometimes renewed or the varieties changed by cleft-grafting. This is done in the manner described for cleft-grafting the apple, except that usually the soil is drawn away from around the plants and the vines sawed off below ground at least three or four inches. The vine is split open and two scions inserted and the earth packed around them. It is not necessary to use grafting wax on the wound. The soil should be drawn around the scions, leaving only one bud of each above ground.

Single Eye Cuttings

When wood for making cuttings is very valuable or scarce, rapid propagation is effected by means of single eye cuttings, using either the matured wood of the new growth in fall or the green growing wood in summer. The cuttings in either case are made by using only one joint for each, and must be started into growth by being covered an inch deep, while lying flat in a sand box or bed in a greenhouse or hotbed. Single eye cuttings make weak vines.

W. L. Howard

Grapes in Northeastern United States

Next to the Pacific coast region, that section of country known to horticulturists as District No. 2, is the greatest grape growing section of the United States. (See Page 192.)

This section includes Nova Scotia, Maine, below 500 feet elevation; New Hampshire and Vermont, south of latitude 44 degrees; Massachusetts, Rhode Island, Connecticut, New York, south of latitude 44, except Long Island; North New Jersey; above 500 feet elevation; Pennsylvania, east of the Susquehanna river and above 500 feet elevation, north of latitude 41, west of the Alleghaney river, and all that portion of the state lying north of the Ohio river; Ohio and Indiana, north of latitude 40 degrees; the lower peninsula of Michigan; and Ontario south of Atlantic coast, the lake region of Western New York, Ohio, Ontario, Michigan and the Hudson river valley are the leading features of District No. 2.

There are in the Lake Erie valley of Western New York, alone, over 30,000 acres of grapes. This section, in connection with Northwestern Pennsylvania, produces annually over $2,500,000 worth of grapes for the markets.

The following on the culture of the grape is adapted to this region:

Culture

Location

*The ideal location for the vineyard is gently sloping land. Many fine vineyards are located on steep hillsides, yet the

* Circular 19, New York Experiment Station.

liability of washing and difficulty of tillage tend to render such vineyards less productive and shorter lived. The shores about the large lakes appear to be especially well adapted to grapes—these districts in some instances extending several miles back from the water. But very rarely can grapes be grown in our northernmost latitudes without the increased labor and cost of covering in winter, except under the tempering influence of large bodies of water. Low situations that prevent a free circulation of air, such as river bottoms and the basins of small lakes, should be avoided, as such locations are more liable to unseasonable frosts; and also their poor air drainage favors powdery mildew and black rot. There is much difference of opinion as to the direction the rows should run. In the "Chautauqua Grape Belt" the prevailing direction is north and south, where the slope is not too steep. This is ideal for this section, as the morning sun rapidly dries the dew on the east side of the rows while the prevailing wind dries it on the west. The constant west and northwest wind is probably the chief reason why this district is so free from black rot. Where the slope is steep, the rows must necessarily run at right angles to it.

The foregoing does not necessarily mean that the grape can not be grown on level land, for such is not the case. Many fine, vigorous vineyards are so situated, but, as a rule, sloping land has the better natural surface drainage. The region about a large body of water is usually rolling or sloping. Hence, more vineyards are found on the slopes than on the typical flat land.

Soils

Experience shows that grapes may be grown upon a great variety of soils. Productive vineyards are found on loam, sandy loam, gravel, gravelly loam, heavy clay and clay loam. It is not so much a question of the kind of soil, as the condition of that soil as to texture, drainage and fertility, and the possibility of washing. It is true that certain varieties exhibit a soil preference, but most commercial varieties will thrive on many types of soil.

Drainage

The first essential is that there be good drainage. The cultivated grape does not thrive with its roots continuously in water, though it be more tolerant in this respect than most fruits. A natural conclusion prevails that sloping land is well drained; yet this is not always true. Especially where the soil is shallow, an impervious rock or hardpan below may form basins or "kettle" holes in which water is retained and the soil becomes saturated, as the water must rise to the surface to escape. Under such conditions, a slope is as badly waterlogged and as poorly drained as a lowland area. If there be not good drainage, the field should be tiled.

Preparation of Soil

In the preparation of the soil for setting grape vines the grower should exercise the greatest care. A little thought and work before setting will pay for themselves many times over. As a general rule it is poor practice to reset to grape land that has just been in vineyard, without putting under a good green manure crop two or three times before planting. When it is desired to reset land where a vineyard has been pulled out, or even where a new location is selected, sow mammoth clover in August and plow this under just before it blossoms the following summer; then seed it again to clover and plow it under the following spring, when ready to plant. Deep turning under of a green manure crop, followed by thorough dragging and rolling, puts the soil in the best of tilth. Once gotten in good tilth after thorough preparation, it is far easier to maintain in good condition than without such preparation.

In fitting the field, preparatory to planting, plow as deeply as possible, with a two-horse plow, into lands eight or nine feet wide—the width depending on the distance apart which the rows are to be made. This will leave dead furrows eight or nine feet apart. Then with a subsoil plow, go twice through each dead fur-

row. Much of the soil loosened by the subsoil can now be thrown out by again going through each furrow with the two-horse plow, once each way. This insures deep planting and increases greatly the area for root growth.

Vines

The selection of vines is an important part in the foundation of the vineyard. Too often it is neglected altogether, by reason of the inability of the prospective grower to judge vines, or else poor vines are purchased knowingly because they are cheap. A poor vine purchased because of cheapness is a poor investment. A vineyard started with poor vines is handicapped at the start and rarely, if ever, overcomes the burden, even with good aftercare.

First-grade one-year vines are to be preferred to those two years old. They are as a rule much better, though to the amateur a large vine promises more. Very frequently two-year vines represent the poorer one-year vines of the previous season transplanted and allowed to grow in the nursery row another season. Most commercial vineyards are set with one-year vines, while the amateur usually sets those two years old. There are doubtless some good two-year vines, but they are the exception.

Varieties

The Concord is pre-eminently the commercial black grape in New York. In Chautauqua county probably 95 per cent of the acreage is of this variety. The season of good black grapes could be considerably lengthened by planting Moore Early with Concord, as both these varieties stand up well and could be shipped to the most distant markets. Moore Early and Worden are frequently sold as Concord, as are several other black grapes. In the latitude of Western New York, Moore Early ripens about ten days before Concord. If one is close to local markets, Worden should have a place in the commercial vineyard and by all means in the home vineyard. Its quality is excellent, but it will not stand shipping. It ripens about a week before Concord. Worden has proven very productive and its clusters are large, compact, with large berries.

For red grapes, Catawba should certainly be planted where it will thoroughly ripen. It is of good quality and a good keeper. For quality, the Delaware is the grape par excellence and, with close pruning and good feeding, it is a very profitable grape. For green grapes, Winchell, or Green Mountain as it is listed by some nurserymen, should more generally be planted. This is a very early grape, of excellent quality, a good bearer of large-shouldered, compact clusters. For markets that prefer a green grape and one extremely early Winchell will find a ready sale. Niagara needs no recommendation as a market grape and with proper care and especially allowing it to ripen fully, it will become even more popular. By the selection of varieties, black, white and red, that ripen in succession, the grower can overcome to a certain extent the frequent glutting of the market that occurs in seasons of big crops when only one or two varieties are grown in an entire district and all are being shipped to the same markets. On the other hand he must not go to the other extreme and set too many varieties unless these can be handled in car lots or disposed of locally.

Cross-Pollination

Owing to the fact that certain varieties (self-sterile) of grapes will not form marketable clusters when planted by themselves, away from other varieties, it is necessary that the prospective grower learn whether the varieties he is setting be self-fertile or self-sterile. If he is setting both, he should alternate the two classes so as to insure pollen distribution from the self-fertile to the self-sterile. The varieties given in this circular are all self-fertile. Never set varieties known to be self-sterile in large solid blocks.

Distance

There are many recommendations as to distances apart for rows and vines. Some of the older vineyards are set 10 feet by 10 feet, but the prevailing distances are rows 9 feet apart and vines

8 feet. A most suitable distance appears to be 8¼ feet by 8 feet, as an 8½-foot row can be plowed most satisfactorily with a three-gang plow by going twice through the row, and the subsequent tillage with spring-tooth and disc may be economically done. Many of the newer vineyards are being set 8 feet by 6 feet, and some even 8 feet by 4 feet. In this instance the grower plans to take out every other vine as soon as two or three crops have been harvested; or else to leave all and put up but half the wood per vine that is usually put up where they are 8 feet by 8 feet. But observation has shown that orchardists who have set trees closer than they should have been—intending to remove alternate trees when they arrived at maturity—find it exceedingly heartbreaking to remove a healthy bearing tree; and this, no doubt, will hold with the vineyardist who is setting 8 feet by 4 feet with the intention of pulling out each alternate vine.

Planting

The field having been plowed in lands of the desired width, stakes are now set in the furrow at the interval decided upon for the vines in the row. These should be lined carefully each way. Then with the hoe and shovel, the hole is dug in the bottom of the furrow with the stake as the center. This can be readily done, as the plowing has loosened the soil. There is not much danger of setting the vine too deep, but rather the other extreme. The hole should be dug deep enough so that the bottom may be filled in with surface soil, leaving a mound in the center of the hole upon which the base of the vine is to rest. It should be large enough to accommodate the roots without crowding. The roots are cut back more or less severely, depending on their growth and condition, but generally to about eight or ten inches from the base. The top is cut back to two or three buds. The roots are then spread out in the hole so that they are equally disposed in all directions, the base of the vine resting on the mound, with the roots sloping downward at quite an angle; then a little of the surface soil is tamped firmly upon them. More soil is added and firmly packed, until the hole is nearly filled, but the soil last filled in is not tamped, leaving the surface soil loose. The vine should now be deep enough so that the two or three buds of the top are just above the ground. The following winter or spring the growth of the previous season is cut back to two buds, for we should aim, above all else, to get a good, well-established root system. Then at the beginning of the second year we find our vine in apparently the same condition as the year of setting. This spring we should set the trellis posts, putting on but one wire. The trellis is not put up to fix the future training, but to get the canes out of the way for cultivation. Some fruit may set this season, but it should be removed early. The following spring the vine is ready to be trained permanently upon the trellis and a variety of systems are presented. The grower can choose the one he believes best suited for his varieties and local conditions. The labor problem is an important factor to be observed in this selection as it is more costly to prune and tie some systems than others.

Alleys

When the vineyard is to cover more than three acres it is best to provide alleys or driveways for each such area, these to run both parallel and crosswise to the row. They facilitate all vineyard practices, especially cultivation and harvesting, by permitting ready access and shorter hauls. The alleys should be wide enough to permit turning with a two-horse wagon. The tendency is to provide too few alleys rather than too many.

Tillage

Frequent and thorough tillage is very essential for the vineyard. The first spring operation is plowing under the cover crops, with the single horse and gang plows. This can be done as soon as the weather and soil conditions will permit. A single furrow is plowed up to or away from the vines on either side of the row; then follow this with the gang plow, and, if the cover crop was particu-

Kennewick Tokays.

larly heavy, with the disc harrow. The three-gang plow will cover an 8½-foot row in one bout. Where no cover crop was sown, the disc may replace the plow. The subsequent cultivation is done with the grape hoe, hand hoe, spring-tooth harrow, and disc harrow. Just about the time that the root-worm has transferred to the pupa or "turtle" stage and has gotten into the upper layer of the soil, ready to emerge and, as adult, to lay its eggs on the canes, the grape hoe may be used to throw a furrow away from the hills. This exposes the delicate pupal stage of the insect to the sun and other climatic conditions which are very destructive to it. Cultivate at regular intervals of ten days and always just before the soil has crusted from a rain, and especially often in a season of drought. About the first of August discontinue cultivation, the last operations being gang plowing, dragging, and plowing a single furrow up to each side of the hill. Care should be observed to keep the soil level throughout the entire width of the row during the growing season. This insures a more uniform distribution of rainfall.

Cover Crops

The vineyard should be sown to a cover crop at this time by broadcasting and dragging in with the spring-tooth harrow or else drilling it. Before sowing, it is well to watch the weather maps pretty closely and try to sow just before or just after rain. If good cultivation has been given we will have now a good seed bed. Mammoth clover, vetch, Canada field peas, clover mixed with cow-horn turnips, and winter wheat mixed with cow-horn turnips can be used. Mammoth clover sown at the rate of 20 pounds per acre has proven very satisfactory and makes an ideal nitrogenous cover crop for the vineyard. It decays rapidly and adds much nitrogen and humus to the soil.

The next most promising nitrogenous cover crops for the vineyard are hairy vetch and a mixture of mammoth clover (15 pounds) and cow-horn turnips (1 pound per acre). A mixture of winter wheat (1 bushel) and cow-horn turnips (12 ounces per acre) promises a very satisfactory non-nitrogenous cover crop.

In addition to furnishing and liberating plant food in the soil, the organic matter derived from a cover crop improves the mechanical condition and conserves moisture. A crop growing late in the fall, after the vines have ceased growing, also utilizes nitrates that are being formed then and would otherwise be lost by leaching, especially on knolls and hillsides liable to washing. There can be no doubt that the grape does best under frequent and thorough tillage, and this means that organic matter and humus are being rapidly burned out of the soil. Hence the loss must be supplied by the use of stable manure, cover crops, or organic commercial fertilizer.

Intercropping

Many growers grow potatoes, cabbage, beans, etc., between the rows of the young vineyard for the first two years, while others interplant blackberries, raspberries, currants, gooseberries and strawberries for indefinite periods. Observation shows that neither of these plans is in keeping with the best vineyard practices; and both the primary and secondary crops suffer as the result of such systems. The only crop that should be allowed in the vineyard is the cover crop.

Fertilizers

The fertilizers required by the grape are still largely a matter of experiment, and until this phase is thoroughly worked out, the grower must rely on his vines to tell him what is needed. Even should the wood growth indicate a lack of nitrogen, it would not indicate that more nitrogen should be added to the soil, as there might be a sufficiency already present, yet unavailable by reason of poor tillage, lack of drainage and other faulty practices.

Manuring

The above statements will apply equally well to the use of stable manure. It is probable that stable manure does produce vigorous wood growth in some instances and it is just as probable that its direct fertilizing value has been over-

estimated. Its greatest value lies in its power to improve the mechanical condition of the soil by making it more porous and increasing its water-holding capacity.

F. W. GLADWIN,
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HISTORY OF THE PRODUCTION OF RAISIN GRAPES IN CALIFORNIA

The grapevine has long been cultivated in California. The mission fathers were the first to grow successfully the European grape in that state. They had but one variety, which is still largely grown, and is known by the name of the Mission grape. It was planted at San Diego in 1769; San Gabriel in 1771; Los Angeles, 1781, and Santa Barbara in 1786, and was largely used for wine making. It was nearly 80 years later before the raisin grape was introduced into California.

The First Introduction of the Raisin Vine

In 1851 Colonel Agostin Haraszth, of San Diego, grew some Muscatel vines from seeds of Malaga raisins. In March, the following year, he imported the Muscat of Alexandria from Malaga, Spain, and ten years later, during a visit to that place in September, 1861, he selected cuttings of the Gordo Blanco, which were afterwards grown and propagated in his vineyard in San Diego county. He was thus the first to introduce the raisin vine into California. Another importation of the Muscat of Alexandria was made in 1855 by A. Delmas, and planted at San Jose. G. G. Briggs, of Davisville, also imported Muscatel grapevines from Spain, while R. B. Blowers, of Woodland, Yolo county, started one of the first raisin vineyards in 1863 from Gordo Blanco cuttings received from Colonel Haraszth.

Early Vineyards in Southern California

In the more southern parts of the state, Riverside entered the field in 1873, when Judge John Wesley North, the founder of the colony of that name, first planted the Muscat of Alexandria; but grape growing in that district did not become general until about three years later. In El Cajon valley, San Diego county, the same variety of raisin vines was planted by R. G. Clark, in 1873, but most of the vineyards in that county were not planted until 1884-86. In Orange county raisin grapes were also planted about the year 1875-76 by MacPherson Brothers, who, at one time, were the largest growers and packers in the state. Raisins were also produced in San Ber-

Moore's Early. Wonder.
—*Maxted Photo*

nardino and Los Angeles counties in former years, but owing to the ravages of what has since become known as the Anaheim disease, which destroyed thousands of acres from 1884 to 1889, growers became discouraged, and oranges and lemons have taken the place of vines almost entirely.

Beginning of the Raisin Industry in Central California

In 1876, W. S. Chapman imported some of the best obtainable Muscat vines from Spain for the Central California Colony in Fresno county, which, however, proved in no way different from those already growing in that county. Who produced the first raisins in California will probably never be satisfactorily proved. According to a report of the California State Agricultural Society, raisins were exhibited by Dr. J. Strentzel at the state fair in 1863. The first successful raisin vineyards in the state were those planted by G. G. Briggs, of Davisville, in Solano county, and by R. B. Blowers of Woodland, Yolo county. The former vineyard contained mainly Muscats of Alexandria, and the latter, Gordo Blanco. Both these vineyards produced raisins as early as 1867, but it was not until 1873 that any quantity was placed on the market.

First Fresno Vineyards

In the fall of 1873, Muscat vines were first brought to Fresno, when 25 acres of the Muscat of Alexandria were planted in the Eisen vineyard. In 1876-77, T. C. White planted the Raisina vineyard in the Central California Colony, Fresno, with Gordo Blanco Muscatels brought from Blowers' vineyard at Woodland. The following year Miss M. F. Austin planted her "Hedgerow" vineyard with the same variety, and Robert Barton also planted 25 acres of Muscat vines, but did not make raisins until later. The Butler vineyard, one of the largest, was first planted in 1879, while Colonel William Forsyth commenced grape growing in 1881-82. Most of his vineyard, however, was planted a year or two later.

Production of Raisins Doubled in Five Years

Twenty-five years ago Fresno county commenced to take the lead, which it has kept increasing ever since, while Southern California, especially Los Angeles and Orange counties, continued to fall off in their production, as illustrated by the following summary:

	1885	1886	1887	1888	1889
Fresno	2,140,000	4,500,000	7,000,000	8,800,000	9,500,000
Riverside and San Bernardino	2,580,000	3,900,000	3,800,000	5,400,000	5,300,000
Los Angeles and Orange Counties	2,780,000	3,600,000	1,700,000	840,000	160,000
Yolo	1,340,000	1,500,000	2,500,000	2,500,000	2,400,000
San Diego	200,000	500,000	400,000	800,000	150,000
Tulare	120,000	160,000	200,000	220,000	300,000
Kern	....	....	....	....	80,000
Other smaller districts	240,000	300,000	400,000	500,000	500,000
Totals	9,400,000	14,460,000	16,000,000	18,860,000	19,740,000

These figures are only an approximation.

Kings county does not appear in this list, as it was then part of Tulare county, not being organized into a separate county until 1893. Within the last 20 years great changes have taken place. Orange and Solano counties no longer produce raisins; Los Angeles county very few; Yolo county, which at one time produced Sultanas and Thompson's Seedless in considerable quantities, now finds it more profitable to ship them as table grapes; while the large vineyards in Riverside and San Bernardino counties are more devoted to wine grapes. Of the 52 counties in California, only ten produce raisins in any quantity:

Twelve Counties Where Raisins are Produced—(Crop of 1909)

	Pounds
Fresno	83,404,000
Tulare	20,000,000
Kings	18,000,000
Sutter	4,500,000
San Bernardino	3,600,000
San Diego	3,200,000
Madera	2,400,000
Yolo	2,000,000
Kern	1,100,000
Colusa	900,000
Los Angeles	600,000
Riverside	296,000
Total	140,000,000

GRAPES IN OREGON

The grape culture has not, as yet, been very highly developed in Oregon; this industry should receive much more attention. There are two sections in the state that are specially adapted for the production of the *Vinifera* or European grape as it is commonly called, near The Dalles and in parts of Southern Oregon in such regions as the Rogue River valley. The best areas are found principally on red hill lands that are provided with good air and soil drainage, have a warm sunny exposure and are out of the fog and frost belt. Such grapes as Tokay, Muscat, Thompson Seedling, etc., grow to the highest degree of perfection, possess splendid quality and are unexcelled by any grapes the writer has ever tasted. There is a large demand for the product and much more attention should be given to this industry.

These lands can also grow the American or table grapes. Much more attention should be given to this product, as we are steadily importing grapes from Eastern points. The Umpqua valley offers a good field for early table or American grapes like the Worden, Concord, Delaware, Niagara and Brighton. These varieties also succeed well in the Willamette valley on the silt loams along the rivers and on the sunny, rich hill lands when such lands are not exposed to cold winds.

The vines are planted in rows about five to six feet apart and the plants from six to eight feet apart in the row, according to the system of pruning. The renewal systems of pruning, in which bearing wood is cut away each year and new bearing wood produced, are the better. Part of the canes should be removed. A strong vine can stand four canes, while some of the weaker growing sorts should have but two canes. At times it is best to limit the number of bunches the vine is allowed to produce, and throw greater vitality into the remaining bunches.

Grapes must be given exceedingly good care the first three years and not be allowed to bear during that period, so that more vitality may be thrown into the growing vines. They will need severe cutting back the first few years and when pruned upright each will produce arms for fruiting. European varieties are usually grown on stumps, although sometimes they are placed on wires, while the American varieties are always grown according to the latter method. — Oregon Experiment Station Bulletin 111.

GRAPE GROWING IN THE SOUTH

Introduction

Grapevines grow well in nearly all parts of the South, and with reasonable care they seldom fail to produce abundant crops. The grape may, therefore, be set down as among the most satisfactory fruits grown in this section. Grapes ripen at a season when other fruits are scarce; their acid flavor is especially agreeable in the warm days of July and August, and they can usually be sold at a fair price. In the South the vines are never injured by severe freezes, and therefore need no winter protection. Occasionally a late spring frost destroys the early blooms, but never hurts the vine enough to prevent its bearing a fair crop of fruit. Few fruit-bearing plants are less particular about the soil in which they grow, and few will yield so much fruit in proportion to the land they occupy and the labor they require. Wild grapes are abundant in the woods throughout the entire region, and wherever grapes are found growing wild the cultivated vines are sure to succeed.

There is no part of the South where grapes of fine quality can not be grown in sufficient quantity for home use, and in many parts they are an exceedingly profitable market crop.

The Question of Soils

Grapes will grow on any soil which is suited to the growing of peaches. The best soil is one which is fertile, but not excessively rich; which is loose and easily worked, and which is underlaid by an open and porous subsoil. Neither thrifty vines nor heavy crops of fruit can be produced on a sterile soil. On the other hand, if the soil be too rich, containing an excess of humus and nitrogenous material, as is usually the case with creek-bottom soils, the vines will make a rank growth, but the fruit will be small, imperfect, sour, and lacking in flavor. The presence of lime in the soil is always beneficial.

The character of the subsoil also is very important. The surface soil is easily changed and modified by cultivating and fertilizing, but the subsoil will remain practically unchanged. As the roots of the vines are easily injured by excessive heat and drought or by standing water, the subsoil should be of such a texture that the roots can penetrate below the reach of intense heat, and still not suffer from too much moisture. When the subsoil is loose and porous it not only permits surplus water to pass down through quickly, but it also assists the water from below in passing back to the surface in times of drought, thus securing to the vine the constant and uniform supply of moisture essential to its healthy growth. Soils underlaid with hardpan, those which are inclined to wash badly, and those which are not naturally well drained should always be

Niagara. —*Maxted Photo*

avoided when selecting a location for an extensive vineyard.

Preparing the Ground

In preparing the ground it should be plowed very deeply, as no loosening of the subsoil is possible after the vines are planted. An excellent plan is to plow the ground in "lands" the width of the rows, making the "dead furrows" come where the vines are to be planted, and running the plow through them several times so as to break up the subsoil to a good depth. This thorough loosening of the subsoil is especially necessary where an underlying hardpan prevents good natural drainage. It will be better if all the ground is subsoiled, and if the work is done some weeks or even months in advance of the planting. Just before planting, the ground should be plowed again, reversing the "lands," so as to make the ridge come where the furrow was. This should leave at least two feet of loosened soil where the vines are planted, and will afford the roots ample room for a free growth, besides doing much to insure them against suffering from drought.

Laying Out a Vineyard

In laying out a vineyard the rows should be made to run as nearly north and south as possible if the vines are to be trained on a trellis, but if only stakes are to be used the rows may be run in any direction. By running the trellis north and south all the fruiting parts of the vine have nearly the same exposure to the sun, while the fruit, main stem, and roots are shaded and protected during the hottest part of the day. Protection of the soil from washing is of first importance, however, and the direction of the rows for any method of training should be made to conform to the slope of the ground when the vineyard is on the side of a hill.

Distance Apart of Vines

The distances between the vines should be somewhat greater than is recommended for Northern vineyards, as the longer growing season produces a heavier growth, and it is never profitable to crowd the vines too closely. The rows should be at least eight feet apart, and the same distance between the vines in the rows is close enough for such moderate growers as Delaware, Elvira, and Gold Coin. Vines of the stronger growing varieties like Concord or Carman should be at least ten feet apart; 12 feet is none too wide for such rank growers as Fern, Laussel, and Herbemont. Some give the stronger vines as much as 16 feet, and find that distance none too great on good soil. Vines of the Scuppernong family should never be crowded, and 8 by 16 or 12 by 12 feet is close enough for them.

Planting

Only strong, one-year-old vines from cuttings or layers should be used for planting. Two-year-old vines are usually larger and heavier, but do not often grow so well or make as good vines as those planted at one year, while the three and four-year-old vines sometimes sold "for immediate bearing" are of very little value. It is more economical and in every way more profitable to pay a good price for good vines than to use old, stunted, or unhealthy vines which cost nothing.

The holes in which the vines are planted should be of sufficient size to give room for the roots to be spread out in their natural positions, say from 15 to 18 inches in diameter, and deep enough to allow the vines to be set about two inches deeper than they grew in the nursery rows. Very little is gained by making the holes larger than is needed. Where they can be secured, it is very beneficial to put a few pounds of bones in the bottom of each hole and cover them with a little soil before the vines are planted. It is not usually possible to do this for a large vineyard, but where only a few vines are planted to furnish fruit for home use a sufficient supply can commonly be found around a slaughter house or in the fields, and they more than repay the trouble of gathering them. No other fertilizer need be used at the time of planting.

The tops of the vines should be cut back to two or three buds. In planting,

the holes should be filled with the finest and richest soil. If the surface soil taken from the holes is rich, fine, and mellow, it will be good enough, but if the vines are being planted in a hard clay or a light, sandy soil, it will pay to haul rich woods soil for filling about the roots. The filling should be packed and tramped down firmly, and a slender, 5-foot stake set by the side of each vine, the stakes being kept in the line of the row, so as not to be in the way of cultivation.

All the vines of each variety should be planted together, and, as soon as the planting is completed, or while it is in progress, a complete record should be made, showing the location of all the vines of each variety.

Propagation
Originating New Varieties

Grapevines are propagated by seeds, layers, and cuttings, and by grafting. Propagation from seeds is employed only for the purpose of originating new varieties. Seedling grapevines may differ widely from the parent stock, and from each other, even when the seeds are from a single cluster of grapes; they require a long time to come into bearing, and their fruit is usually inferior to that of some of the established varieties. Nevertheless, it is by the raising of seedlings that all new varieties are originated, and the man who grows a hundred seedling vines feels amply repaid for all his labor and trouble if he finds among them a single one which produces grapes of superior quality.

Although propagating grapevines from seeds is rarely profitable, the work is of intense interest, and it is the only means by which new and better varieties can be secured. As work of this kind belongs to nurserymen and experimenters rather than practical grape growers, a full treatment of the methods is unnecessary here.

Varieties for Shipping, for Wine, and for Table Use

The better varieties for shipping, as given by the same report, in order of maturity, are Diamond, Moore *Early*, Brighton, Ives, Delaware, Niagara, Concord, Perkins and Diana.

Varieties recommended for wine are Norton, Lenoir, Clinton, Concord, Ives, Thomas, Missouri, Riesling, Catawba, Delaware, Elvira, Warren and Noah.

The Georgia Experiment Station, in its Bulletin No. 28, recommends the following varieties, enumerated in the order of their ripening:

For shipping: Moore *Early*, Delaware, Ives, Niagara, Concord and Carman.

For table or local market: All the varieties named above, with the addition of Presly, Winchell (*Green Mountain*), Bell, Brighton, Brilliant, Empire *State* and Goethe.

For wine: Goethe, Missouri, Riesling, Elvira, Catawba, Herbemont, Delaware, Scuppernong, Norton, Cynthiana, Cunningham, Ives, Concord and Thomas.

Varieties of the Scuppernong family, including Thomas, Flowers, Tenderpulp, and others, should be planted in every vineyard south of latitude 35 degrees, and are especially valuable along the Gulf coast from Texas to Florida. The vines grow with very little care, and the fruit ripens very late, after most other varieties have disappeared.

Cuttings

When vines can be grown from cuttings, it is the simplest and easiest method of propagation. Cuttings of the Labrusca, Riparia, and some of the softer-wooded Aestivalis classes, root very easily. Cuttings should be made as soon as convenient after the leaves drop in the fall, and should be made from strong and well-ripened wood of the present season's growth. Each cutting should have at least three joints, and should be from 8 to 12 inches in length. The cut at the lower end should be made just below a joint, or the cutting should have a short "heel" of old wood. The latter form is the better, but of course only one such cutting can be made from each shoot.

The top of the cutting should be an inch or two above the upper joint, and, as a matter of convenience in handling and planting, the cuttings should be of nearly

equal length. They may be planted as soon as made, or may be tied in bundles and buried in well-drained soil until spring. The making of cuttings may be deferred until late in winter if necessary, but they are much better if made earlier. When made in the fall or early winter they have time to become well calloused, and so are more sure to form roots and grow promptly as soon as the soil becomes warm in the spring than when made later in the season.

Cuttings should be planted in loose, rich, and light soil as early in the spring as the ground is in condition for working. Dig a V-shaped trench, making one side straight and smooth, and a trifle less than the length of the cuttings in depth. Place the cuttings about two inches apart, against the smooth side of the trench, carefully press the lower end of each firmly into the soil, and have the top about even with the surface of the ground. Fill the trench nearly half full with fine soil and then tramp thoroughly, throwing the whole weight of the body on the heel so as to pack the soil very closely about the lower ends of the cuttings. Then fill the trench full, tramp again, and finish by drawing in loose soil to leave the surface level. As much of the success in growing cuttings depends on having good soil packed very closely about the lower ends, special care should be taken in that part of the planting.

Cuttings may be planted more rapidly and more easily by simply opening the soil to the required depth with a spade, and pushing them down into place and then tramping the soil back against them, but when planted in that manner it is impossible to secure uniformly close contact between the soil and the lower ends of the cuttings, and success is much less sure. When properly made and planted in good soil, at least 90 per cent of the cuttings of such varieties as the Concord and Niagara will grow; but of some other sorts, like Norton and Cynthiana, not more than ten per cent can be expected to make vines. The rows of cuttings should be at least four feet apart so as to give ample room for cultivation, and by the end of the season the young vines should have made a growth of from two to four feet or even more. They will then be ready for planting in the vineyard at any time after the first frost in the fall, or they may remain in the original rows until spring. This is the most common method of propagation, and fully 90 per cent of the vines sold by nurserymen are raised in this way.

Layering

All varieties may be propagated by layering, and many varieties, especially those like Norton, Cynthiana, Scuppernong, and other hard-wooded sorts of the Aestivalis and Rotundifolia classes, can not be easily propagated by any other means. Layering should be done either in early spring or late in the summer, the spring layering being the more economical and making the better plants. For spring layering a trench of two or three inches in depth is dug, and a cane of the last season's growth is laid into it and fastened in place with a few wooden or wire pegs. When the young shoots from this cane have made a growth of from 6 to 12 inches, the trench should be filled with fine soil, well tramped in, and the shoots tied to stakes to keep them out of the way of cultivation. When treated in this way the canes laid in the trench will usually make both shoots and roots at each of the covered joints, and so make as many new vines as there are shoots. The trenches should be made lengthwise of the rows, so they will be out of the way, and in digging the young vines should be separated by cutting the canes just beyond the shoot nearest the parent vine.

Layering may be done in midsummer by bending down and covering shoots of the present season's growth, but it is not often possible to secure more than one or two new vines from each shoot. If the layering is done very late in the season, it is safer to cut a tongue on one side of the shoot which is buried, making the tongue an inch or two in length and about one-third the thickness of the shoot, as roots will start more quickly from such a cut surface than where the

bark is unbroken. When treated in this manner many varieties will make strong roots by spring, even when the layering is done as late as September or October. Propagation by layering is more sure than by cuttings, and it is often more convenient and satisfactory when only a few new vines are wanted. It has the further advantage of being practicable in summer when cuttings could not be made to grow.

Plants grown from layers are not so convenient for handling and planting as are those grown from cuttings, but there seems to be no difference in the growth or productiveness of the matured vines.

Cultivation

Grapevines need no special cultivation beyond that necessary to keep them free from weeds, and all the cultivation given should be very shallow, in order to avoid injury to the roots. Ordinarily the first working in the spring should be done with a one-horse turning plow, beginning in the middles and backfurrowing, so as to throw the soil away from the vines. The narrow strips left along the rows should be cleaned off with a hoe, fertilizers should be scattered in the open furrows on both sides of each vine, and the ground plowed again, the soil being thrown toward the rows at the second plowing, thus covering the fertilizer. For the later workings there is nothing better than an ordinary five-toothed cultivator and an occasional hoeing along the line of the row. Cultivation should cease when the growing fruit begins to weight down the vines, but as soon as the crop has been gathered the middles should be run through with a cultivator and the ground seeded with cow peas or crimson clover, both for their fertilizing effect and for the protection they afford the ground during the winter.

Pruning

The training and pruning of grapevines is the most important item in their management, and it is in this part of the work that the greatest number of mistakes occur, although the principles involved are really very simple and easily learned by any one who will give them a little thought and attention.

Definition of Terms

The terms commonly used in speaking of the different parts of a vine are as follows:

A *shoot* is a green or immature growth less than one year old.

A *cane* is a matured shoot.

An *arm* is a cane two or more years of age, and is a permanent part of the vine, which is usually fastened to the trellis in a horizontal position, and on which the spurs and branches are produced.

A *branch* is a division of an arm or shoot.

A *spur* is a cane which has been shortened to from one to three joints; if left longer it is usually called a cane.

The *stem* is the permanent portion of the vine below the arms or canes. Where the stake or renewal system of training is followed the stem may be only a few inches in length, while in the canopy system of training it reaches to the top of the trellis.

Objects in View

Most other fruiting plants do better with very little pruning, as the object is to secure the greatest possible amount of fruit from each plant and to make each plant grow as large as possible; but with grapes the object is to secure the greatest possible yield of fruit per square rod or per acre, and not per plant. While a single grapevine bears less fruit when trained to a trellis and kept pruned to a few feet in length than when allowed to grow at will over the tops of trees, the yield of fruit in return for the time, labor and expense is much greater when the vines are restricted to a convenient size and are trained in a somewhat unnatural form; hence, in cultivation, extended growth of vine is sacrificed to secure an increased yield of fruit.

The objects to be kept in view in pruning are to keep each vine within its allotted limits and make it assume the form desired, to remove any useless parts and so secure a more vigorous growth of productive wood, and to remove an excess of fruit. It should always be kept in mind that the fruit of the next season will be borne on shoots of this season which were produced on wood grown

last season, and that it is usually desirable to remove as much of the old wood as is possible and at the same time to leave as much of the new wood as the vine can support with a thrifty and fruitful growth. As each bud on the spurs will probably produce a new shoot, and as each shoot will ordinarily produce from two to six clusters of fruit, the number of clusters being quite uniform for each variety, the amount of fruit which may be expected from each vine can be estimated quite closely, and the pruning should be done accordingly. When too much bearing wood is left and the amount of fruit produced is excessive, both the clusters and the berries will be smaller, and the vine may be so weakened as to require several years to recover a healthy growth. Too close pruning should also be avoided, as it lessens the opportunity for fruit bearing, and causes an excessive growth of coarse and sappy vine. The after effects of too close pruning are rarely harmful to the vine, and there is far less danger in pruning too closely than in permitting the vine to grow at will or to produce an excessive crop at the expense of its future thrift. The natural tendency of a vine is to make its most vigorous growth from the buds farthest from the roots, and, whatever method of pruning and training may be adopted, the aim should be to confine the growth very near the root or main stem.

Time of Pruning

In winter pruning, ordinary varieties should have from one-half to three-fourths of the entire vine cut away. This work may be done at any time after the leaves drop in the fall, and should be done before the buds begin to swell in the spring. Late pruning is better than no pruning, but permits a great loss of sap which would have been used in the development of new growth if the work had been done at the proper time.

Summer pruning is of great value in giving the vine its desired form, in removing an excess of fruit, in making that which is left larger and of better quality, and in making the next winter pruning simpler, easier and more satisfactory. This summer pruning should begin by the removal of surplus shoots as soon as the first growth starts in the spring, so that the entire strength of the vine may be used in the directions where it is wanted, and should be repeated two or three times at intervals of a week or ten days. In many vineyards this is the only summer pruning given, but the vines will bear more evenly, produce better fruit, and be longer lived if any excess of fruit clusters is removed as soon as they appear, and if the fruit-bearing shoots are broken off so as to leave only two or three joints beyond the last cluster of fruit. All summer pruning should be done so early in the season and so promptly that no tools are needed for the work; it should all be done while the new shoots are still so young and tender that they are easily broken off with the thumb and finger. When the wood has become so firm that it will not break easily it may as well remain on the vine until the next winter. Pruning late in summer, or the removal of leaves so that the sun will hasten the ripening of the fruit, is never profitable. It costs time and strength for the vine to develop leaves, but when they are once fully grown they become feeders instead of consumers, and every one should be preserved.

As the system of pruning adopted must depend on the style of trellis used, the subject will be treated further in connection with systems of training.

Gathering and Packing

For home use or for making wine, grapes should not be picked until they are fully ripe. Many varieties become highly colored some days, or even weeks, before they are fully matured; but they are not really ripe and in the best condition for use until the stem of the bunch begins to shrivel or soften so that it can be easily bent. Even for market, the fruit should not be gathered until very nearly matured, as it ripens but little after being removed from the vine. The unripe fruit may soften somewhat on its way to market, but does not be-

come sweeter or better flavored, and will retain the excess of acid which disappears when the grapes are ripened on the vines.

Gathering grapes for market should be done only in fair weather when the vines and fruit are not wet with either dew or rain. The stems should be cut with a knife or scissors and the bunches should be laid in shallow wooden trays or baskets for carrying to the packing shed. Baskets holding five, eight or ten pounds, with covers fastened on by wire hooks, are the best packages in which to ship, as they are inexpensive, easily handled in transportation, and convenient and tempting to purchasers. The fruit should be allowed to lie a few hours so that the stems will become slightly wilted; and all diseased, unripe, or bruised berries should be removed before packing begins. The bunches should be placed in the baskets with the stems downward and packed snugly, the smaller bunches being used to fill the spaces between the larger ones. The top of the fruit should be about half an inch above the top of the basket and should be even and level. The baskets should be so full that some pressure will be needed to bring the cover down into place, though the pressure should not be so great as to crush the grapes or break them from the stems. A basket which is not packed closely will never carry the fruit in good condition; and, as the fruit is sold by weight, close packing is economical. The name of the variety, as well as the name and address of the grower, should be stenciled on the tops of the covers before they are put in place. Mixed or inferior fruit will seldom pay for shipping and will never add to the good reputation of the grower.

Nearly all of our grapes ripen in July or August while the weather is still warm and it is difficult to keep them any great length of time without placing them in cold storage, which is expensive. They can be kept a short time by wrapping each bunch in paper and putting them in a cool place. Still better results will be secured by placing a layer of cotton batting in the bottom of the box, then a layer of fruit covered by another layer of batting. Not more than two layers of fruit should be placed in a box, and the upper layer should have a thick covering of cotton. Neither of these methods will be found profitable for market purposes, but will often be desirable when a little fruit is to be kept for some special purpose. There is considerable difference in the keeping qualities of different varieties, and, in general, the late-ripening sorts will keep longer after being gathered than will those which ripen early in the season.

Influence of Nativity

As the character of every seedling is determined by the ancestry and environment of the growing seed, it is only reasonable to look for the best varieties for cultivation in any given locality among those springing from seeds which were grown in the same or a similar region. Among the native grapes there are certain species which succeed best in certain localities, some being quite local, while others are found widely distributed. The same vital principle which governs the range of the native species also controls the range of the cultivated sorts, and the best varieties for cultivation in any locality will usually be found among the descendants of those species which grow wild in the same region. Among the valuable hybrid varieties it is rare to find a satisfactory one which is not, in part at least, descended from the wild native species of the locality. The Vinifera varieties, which are the common sorts in Europe and in California, are generally worthless in the Southern states, and their hybrids, even those having only a small percentage of the foreign stock, usually show great liability to disease.

The Labrusca is native to the northeastern part of the United States, and there the varieties of that parentage, like Concord, Moore *Early*, Catawba, and others, are among the best; but farther south, where the wild Labrusca is unknown, they are less desirable. They become less valuable the farther they are removed from their place of origin, and, in the extreme South, they are weak in

growth, short-lived, and uneven in ripening their fruit. While many of the varieties which succeed well in the extreme South are derived more or less from Labrusca, nearly all have been derived in part from some of the species native to that region. In the Carolinas and in the mountain region of Northern Georgia and Alabama, many of the pure Labrusca varieties do well, but farther south and southwest they are generally unsatisfactory, while those varieties descended from Lincecumii or Bourquiana blood are usually long-lived and prolific. It is such a well-established fact that much of the whole character and usefulness of a variety depends on its ancestry, that many nurserymen now give the pedigree of each variety in their catalogues, a practice which is of great assistance to the purchaser in making a selection suited to his particular locality.

Varieties for the South in General

The species which have been most prolific of varieties suited to the Southern climate and soils are *Rotundifolia*. *Vulpina*, *Riparia*, *Bourquiana* and *Lincecummii*, though a few good sorts have been developed from *Cordifolia*, *Aestivalis*, *Munsoniana*, and others. A few valuable varieties have been produced from hybrids of various species with the *Vinifera* or European grape, many of them giving fruit of very high quality, but the vines are usually short-lived, and the clusters uneven and unattractive in appearance.

No one variety of grape is suited to all localities, nor does any one variety cover all the needs of any locality. Few varieties are in their prime of fruiting more than ten days or two weeks, while the time between the ripening of the earliest and the latest sorts is more than two months. Every vineyard intended to produce fruit for home use should contain early, medium, and late ripening varieties even when it consists of only three vines. When a dozen or more vines are planted the selection of varieties should be such as will not only give a succession in ripening, but fruit of different flavors and qualities at each successive period. It requires no more room, labor, or expense to plant and care for a vineyard which will yield fruit constantly during two months than for one which matures all its fruit within two weeks Those who plant for shipping to a distant market or for making wine will usually find it better to grow only one or two varieties, but for a local market and for home use the larger the assortment of good varieties the better.

The number of good varieties is now so large and the characteristics of the different kinds are so varied that it is not difficult to secure sorts which will be healthful, vigorous, and prolific on every fertile soil, though, as already stated, the choice of varieties should be governed by locality, soil, and the use to be made of the fruit. The black waxy soils of Texas, the sandy coast soils of Mississippi and Alabama, and the mountain regions of Georgia and the Carolinas need very different assortments to give the best results.

S. M. Tracy, M. S,
Farm Bulletin 118

IMPORTANCE AND CHARACTERISTICS OF THE SCUPPERNONG

F. C. Reimer

The Scuppernong was the first American or native grape to be brought into cultivation. It has always been the most important variety of this species and has been more generally planted than all of the other Muscadines combined. It became popular as soon as introduced because of its great hardiness—growing and bearing well under neglect, and producing an excellent table grape and wine.

The vine is a vigorous grower and attains immense size, as is seen by Fig. 1, which shows a Tyrrell county vine measuring seven feet six inches around the trunk. It is notably healthy, not being seriously affected by either insects or diseases, and is generally a regular and heavy bearer when growing on suitable soils. It is long-lived; some of the vines now bearing good crops are more than a hundred years old. One marked peculiarity of the vine is the splitting-up of the main trunk into several divisions,

Fig. 1. Characteristic Old Scuppernong Trunk. Circumference seven feet six inches. (F. C. Reimer, North Carolina Experiment Station.)

when it becomes very old; also the production of aerial roots when trained on arbors. The vine can be quite readily distinguished from the dark-fruited varieties by the light-colored ends and nodes of the young shoots, the whitish or light-green tendrils and new growths of the aerial roots.

The flowers are perfect, and appear during June in North Carolina. Flowers (and fruit) are borne on the new wood, and not on the old wood, as some of our popular writers have stated. The clusters vary considerably in size, containing from one to 25 berries, usually being much larger on sandy than on clay soils. The berries are round, large, often becoming an inch in diameter; the color varies from pale green to golden russet; skin thick but tender for a Muscadine. The pulp is tender, juicy, with a sweet, rich, characteristic aromatic flavor; and the quality is very good, especially when grown on sandy soils. The chief defects of this grape are the readiness with which the berries shatter from the cluster when fully ripe, and the irregularity of ripening of the berries even on the same cluster. The ripening period covers the entire month of September in North Carolina.

The Scuppernong is distinctly a wine grape. It makes a rich, light-colored wine, which has no superior among sweet wines. The large plantings in this state, some of which cover from 100 to 600 acres, were made primarily for wine production. A bushel of fruit will produce from three to four gallons of wine.

It is also a good table grape when used soon after gathering; but as the skin is often broken in picking, where the stem is attached, the fruit sours readily during warm weather. It cannot be shipped successfully except when used for making wine.

This is distinctly a grape for sandy soils, and should never be planted extensively on heavy clay. It is more productive, and the clusters and berries are larger, more juicy and of better quality on sandy or sandy-loam soils than on clay soils.

VARIETIES OF GRAPES FOR TEXAS

There is no fruit which is so generally grown in Texas as the grape. There is no considerable area for which there may not be selected a few kinds which are suited to the soil and local conditions, and hence produce abundantly. For the eastern portion of the Coast District, the Niagara does well almost universally. It seems to be short-lived, hence a few vines should be planted every few years to keep up the vineyard. Black Spanish, or Lenoir, and also Herbemont, do well in this area. Concord fruit does well, as a rule, but does not ripen its berries evenly in the cluster.

In Eastern Texas the varieties named for the east coast do well, and a long list of others. For the southwest, or semi-arid coast, from Rockport on southwest and south, and for some miles to the interior, most all the leading commercial varieties of grapes do well. They are also designated in our horticultural literature as European varieties. The southwest coast of the semi-arid belt is well adapted for producing such varieties as the Malaga, Flame Tokay, Black Hamburg and a number of other leading

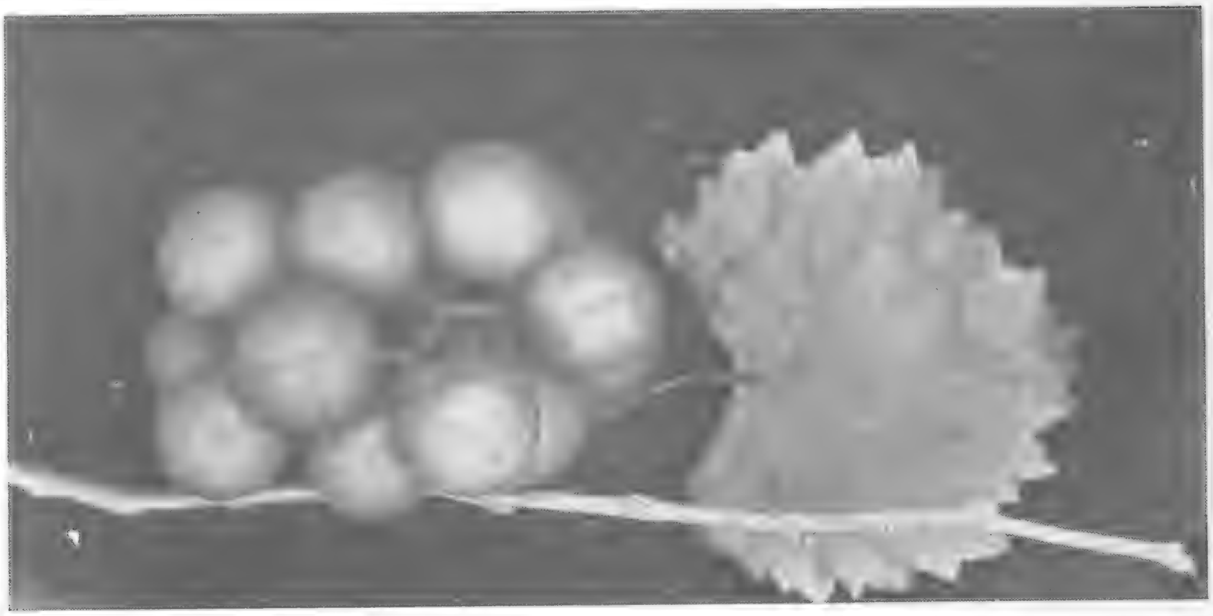


Fig. 2. Exceptionally Fine Cluster of Scuppernong Grapes.
(F. C. Reimer, North Carolina Experiment Station.)

kinds so popular in the markets. Of course, this southwestern belt of the state must be understood as an irrigation section. When grapes are well cultivated and properly irrigated, they produce well and mature and develop as high a flavor and color in this belt as in California.

Thus far there is no trace of *phylloxera* on grapes in this belt. The vineyardists should be certain to get healthy vines which are free from this pest. There are resistent stocks upon which these varieties can be grafted, and thus secure immunity from this dreaded insect pest. Once this pest gets a hold and is left to breed and multiply, it will spread very rapidly to other vines and other vineyards.

Central Texas, North Texas, the Red River Belt, East Texas and Central East Texas all are blessed with one or the other of the leading varieties, succeeding and producing luscious fruit most bountifully. But in the whole territory thus far mentioned, and for all kinds of grapes noted as suited to the respective areas, all require spraying to secure best results. The leaves blight, or have the spot disease, and in other cases the fruit rots badly in the clusters. The vines of these varieties should be sprayed thoroughly with Bordeaux mixture before the buds start in the spring, then again just before the blooming period and again just after the blooming period; the fourth treatment may be given two weeks after the third, and again two or three weeks after the fourth. Care must be taken not to spray the berries just a short period before they ripen.

But for an area in Texas which seems especially well suited for grape culture, the Panhandle and Llano Estacado territories certainly claim most careful and serious attention. The Concord, Triumph, Carman, Beacon and many others of the same type do well. The plants are specially vigorous, and even when the first blooms are killed by a late frost they often produce the second, or even the third, crop of blossoms and mature many splendid clusters of fruit. In no area in Texas will the foliage remain as healthy, bright and vigorous during trying seasons as in this area. Hundreds of small family vineyards have been examined in a season and but few neglected vineyards have shown leaf blight of any kind. In fact, no similar domain exists in Texas for growing grapes successfully with as little spraying. Texas should produce more grapes. The soils and climate should be more closely studied by districts. Texas has within its vast miles of areas soils so composed and so located as to successfully and profitably produce grapes of commercial value, provided the proper types and blood relationships be kept in mind in choosing varieties for any given locality.

John S. Kerr

Varieties

Varieties of grapes recommended by the American Pomological Society for the various districts in the United States: See page 192.

District No. 1

HIGHLY RECOMMENDED — *Dessert and Market:* Diamond; Herbert; Lindley; Moyer; Victor; Worden. *Market:* Cottage; Moore *Early;* Niagara. *Dessert:* Brighton; Lady; Winchell (*Green Mountain*).

RECOMMENDED—*Dessert and Market:* Agawam; Barry; Delaware; Massasoit; Merrimac; Murray; Salem; Vergennes; Woodbury. *Market:* Concord; Hartford; Wilder. *Dessert:* Duchess; Eumelan; Nectar. *Wine:* Clinton.

District No. 2

HIGHLY RECOMMENDED — *Dessert and Market:* Agawam; Catawba; Delaware; Diamond; Lindley; Massasoit; Salem; Vergennes; Worden. *Market:* Concord; Moore *Early*; Niagara. *Dessert:* Brighton; Winchell (*Green Mountain*).

RECOMMENDED—*Dessert and Market:* Barry; Herbert; Isabella; Merrimac; Moyer; Victor. *Market and Wine:* Ives. *Market:* Champion; Cottage; Hartford; Perkins; Pocklington; Wilder; Woodruff. *Dessert:* Diana; Duchess; Empire *State;* Eumelan; Goethe; Hayes; Iona; Jefferson; Lady; Prentiss; Ulster. *Wine:* Clinton.

RECOMMENDED FOR TRIAL—*Dessert and Market:* Murray; Woodbury. *Dessert:* Nectar.

District No. 3

HIGHLY RECOMMENDED — *Dessert and Market:* Herbert; Worden. *Market:* Concord; Cottage; Moore *Early;* Niagara. *Dessert:* Lady; Nectar.

RECOMMENDED—*Dessert and Market:* Agawam; Catawba; Diamond; Lindley; Salem. *Market and Wine:* Ives. *Market:* Champion; Hartford; Perkins; Wilder. *Dessert:* Brighton; Empire *State;* Goethe; Prentiss; Ulster; Washington, *Lady;* Winchell (*Green Mountain*). *Wine:* Clinton.

RECOMMENDED FOR TRIAL—*Dessert and Market:* Brilliant.

District No. 4

HIGHLY RECOMMENDED — *Dessert and Market:* Brilliant; Delaware; Worden. *Dessert and Wine:* Flowers. *Market and Wine:* Ives. *Market:* Concord; Cottage; Moore *Early*; Niagara. *Dessert:* Brighton. *Wine:* Norton *Virginia*; Scuppernong; Tenderpulp; Thomas.

RECOMMENDED—*Dessert and Market:* Agawam; Barry; Carman; Catawba; Herbert; Jaeger, *Herman;* Lindley; Lutie; Massasoit; Merrimac; Muench; Salem; Superb; Vergennes; Victor. *Dessert and Wine:* Eden; Herbemont. *Market:* Champion; Hartford; Perkins; Woodruff. *Dessert:* Berckmans; Duchess; Elvira; Eumelan; Goethe; Hayes; James, Jefferson; Lady; Olita; Triumph; Washington, *Lady*; Winchell (*Green Mountain*). *Wine:* Clinton; Cynthiana; Noah.

RECOMMENDED FOR TRIAL — *Dessert:* Nectar.

District No. 5

HIGHLY RECOMMENDED — *Dessert and Market:* Carman; Delaware; Diamond; Muench; Superb; Worden. *Market:* Moore *Early*; Wilder. *Dessert:* Brighton; Empire *State;* James; Olita. *Dessert and Wine:* Eden; Flowers. *Wine:* Cynthiana; Scuppernong; Tenderpulp; Thomas.

RECOMMENDED—*Dessert and Market:* Agawam; Barry; Brilliant; Catawba; Herbert; Isabella; Lindley; Lutie; Massasoit; Salem; Vergennes, *Market:* Concord; Cottage; Niagara; Perkins; Woodruff. *Dessert:* Berckmans; Diana; Duchess; Elvira; Iona; Jefferson; Lady; Ulster; Walter; Winchell (*Green Mountain*). *Dessert and Wine:* Herbemont. *Market and Wine:* Ives. *Wine:* Noah.

RECOMMENDED FOR TRIAL — *Dessert:* Eumelan. *Raisin:* Alexandria, *Muscat of.*

District No. 6

HIGHLY RECOMMENDED—*Dessert:* James; Memory; Mish.

RECOMMENDED—*Dessert and Market:* Catawba; Diamond; Lenoir; Lindley; Jaeger, *Herman;* Worden. *Dessert and Wine:* Herbemont. *Market and Wine:* Ives. *Market:* Niagara. *Dessert:* Jefferson; Olita; Olivet *Cadinet.*

District No. 7

HIGHLY RECOMMENDED — *Dessert and Market:* Bailey; Brilliant; Carman; Delaware; Diamond; Gold Coin; Laussel. *Dessert and Wine:* Flowers; Herbemont. *Market and Wine:* Ives. *Market:* Moore *Early;* Niagara; Wilder. *Dessert:* James. *Wine:* America; Cynthiana; Norton *Virginia;* Scuppernong; Tenderpulp; Thomas.

RECOMMENDED—*Dessert and Market:* Beacon; Catawba; Dracut Amber; Jaeger, *Herman;* Lenoir; Lindley; Muench; Rommel; Vergennes; Worden. *Market:* Champion; Concord; Cottage; Hartford; Perkins; Pocklington. *Dessert:* Berckmans; Black Hamburg; Brighton; Calabrian; Empire *State;* Griesa, *Piedmont;* Jefferson; Olita; Olivet *Cadinet;* Peru, *Rose of;* Prince, *Black;* Triumph; Winchell (*Green Mountain*); Wylie. *Wine:* Bell; Clinton; Fern *Munson;* Mission; Missouri Riesling; Noah. *Raisin:* Alexandria, *Muscat of.*

District No. 8

HIGHLY RECOMMENDED — *Dessert and Market:* Delaware; Worden. *Market:* Concord; Moore *Early;* Niagara; Pocklington; Woodruff. *Dessert:* Elvira; Goethe.

RECOMMENDED—*Dessert and Market:* Agawam; Barry; Carman; Catawba; Diamond; Jaeger, *Herman;* Lindley; Merrimac. *Dessert and Wine:* Herbemont, *Market and Wine:* Ives. *Market:* Cottage; Hartford; Perkins. *Dessert:* Brighton, Empire *State;* Triumph; Washington, *Lady;* Winchell (*Green Mountain*). *Wine:* Cynthiana; Missouri Riesling; Norton, *Virginia.*

District No. 9

HIGHLY RECOMMENDED — *Market:* Janesville. *Dessert:* Winchell (*Green Mountain*).

RECOMMENDED — *Dessert and Market:* Delaware. *Dessert:* Empire *State.*

RECOMMENDED FOR TRIAL—*Dessert and Market:* Brilliant.

District No. 10

HIGHLY RECOMMENDED — *Dessert and Market:* Agawam; Delaware; Worden; Bailey; Brilliant; Carman; Catawba. *Market:* Concord; Moore *Early;* Wilder. *Raisin:* Muscat of Alexandria; Thompson (*Seedless*).

RECOMMENDED — *Dessert and Market:* Barry; Lindley; Salem; Beacon; Lenoir. *Market:* Champion; Hartford; Niagara; Pocklington. *Dessert:* Brighton; Eumelan; Iona; Lady. *Market and Wine:* Ives. *Wine:* America; Scuppernong; Herbemont.

District No. 11

HIGHLY RECOMMENDED — *Dessert:* Flame Tokay. *Raisin:* Alexandria, *Muscat of.*

RECOMMENDED — *Dessert:* Black Hamburg; Malaga. *Wine:* Mission.

District No. 12

HIGHLY RECOMMENDED — *Dessert and Market:* Agawam; Delaware; Isabella; Lindley; Salem; Worden. *Market:* Concord; Moore *Early;* Niagara. *Dessert:* Black Prince; Brighton; Duchess; Goethe; Prentiss; Sweetwater, *White.* *Wine:* Mission; Zinfandel. *Raisin:* Alexandria, *Muscat of.*

RECOMMENDED — *Dessert and Market:* Barry; Catawba; Diamond; Herbert; Massasoit; Vergennes; Victor. *Dessert and Wine:* Herbemont. *Market and Wine:* Ives. *Market:* Champion; Cottage; Hartford; Perkins; Pocklington; Wilder; Woodruff. *Dessert:* Berckmans; Black Hamburg; Black Morocco; Cornichon, *Black;* Diana; Elvira; Empire *State;* Elvicand; Flame Tokay; Hayes; Iona; Lady; Olita; Peru, *Rose of;* Ulster; Walter; Washington, *Lady.* *Wine:* Clinton; Cythiana; Noah; Norton, *Virginia.* *Raisin:* Sultana.

District No. 13

RECOMMENDED — *Dessert and Market:* Diamond.

District No. 14

HIGHLY RECOMMENDED — *Dessert and Market:* Delaware; Worden. *Market:* Concord; Moore *Early;* Niagara. *Dessert:* Black Hamburg; Sweetwater, *White.* *Raisin:* Alexandria, *Muscat of.*

RECOMMENDED—*Dessert and Market:* Diamond; Isabella. *Dessert and Raisin:*

Thompson *Seedless*. *Market:* Pocklington. *Dessert:* Black Prince; Brighton; Flame Tokay; Peru, *Rose of*. *Wine:* Zinfandel.

Recommended for trial—*Dessert and Market:* Agawam. *Dessert:* Emperor. *Market:* Wilder.

District No. 15

Highly recommended — *Market:* Concord. *Dessert:* *Sweetwater*, White.

Recommended — *Dessert and Market:* Delaware; Diamond. *Market:* Moore *Early*. *Dessert:* Black Hamburg. *Wine:* Mission.

Recommended for trial—*Dessert and Market:* Worden.

District No. 16

Highly recommended — *Wine:* Zinfandel.

Recommended — *Dessert and Raisin:* Thompson *Seedless*. *Dessert:* Black Hamburg; Cornichon, *Black;* Emperor; Flame Tokay; Pierce; Peru, *Rose of;* Sweetwater, *White;* Verdel. *Wine:* Mataro; Mission; Riesling, *Johannisburg*. *Raisin:* Alexandria, *Muscat of*.

District No. 17

Highly recommended — *Dessert:* Flame Tokay. *Raisin:* Alexandria, *Muscat of*.

Recommended — *Dessert and Raisin:* Gordo Blanco (*Muscatel*); Thompson *Seedless*. *Dessert:* Black Hamburg; Black Morocco; Cornichon, *Black;* Malaga; Palomino (*Golden Chasselas*); Peru, *Rose of;* Sweetwater, *White*. *Wine:* Zinfandel. *Raisin:* Sultana.

Recommended for trial—*Dessert:* Emperor; Pierce.

District No. 18

Highly recommended — *Dessert and Raisin:* Thompson *Seedless*. *Raisin:* Alexandria, *Muscat of*. *Wine:* Mission.

Recommended—*Dessert:* Black Morocco; Black Prince; Cornichon, *Black;* Flame Tokay; Black Hamburg; Peru, *Rose of;* Sweetwater, *White*. *Dessert and Raisin:* Gordo Blanco (*Muscatel*). *Raisin:* Sultana. *Wine:* Zinfandel.

Aven Nelson, secretary State Board of Horticulture, Laramie, Wyoming, recommends the following varieties for that state:

Moore's *Early;* Brighton; Concord; Beta and Janesville.

Brighton. Concord.

—*Maxted Photo*

HOME MANUFACTURE AND USE OF UNFERMENTED GRAPE JUICE

Unfermented grape juice has no doubt been used ever since wine has been made from the grape. The following practical suggestions will enable housewives to put up unfermented juice at the time of the fruit harvest, and thus to utilize much fruit that is now annually lost through inability to preserve it in the fresh state. In this form it is a pleasant, wholesome drink and food well adapted to home use. On some farms enough such preventable waste occurs almost every year to largely reduce the possible profits, or even to cause failure to meet the running expenses of the farm. By preventing this waste an unprofitable farm may often be made profitable.

Historical Notes

Galenius, the Greek physician and writer, says (A. D. 131): "A good many Asiatic wines were stored in bottles which were hung in the corner of fireplaces, where, by evaporation, they became dry." This process was called "fumarium."

The Greeks had two kinds of wine, "protoplon," or first juice of the grape before pressing, and "denterion," or pressed juice. The Romans called them "*vinum primarium*" and "*vinum secondarium*." Some of them drank the juice before fermentation had started, and called it "*mustum*." After the must or juice had been through a heating process (called "reduction" nowadays), they called it "*frutum*," and when, after long heating, it had been reduced to one-half or one-third its original volume, they called it "*sapa*." This was used by the Romans on their bread and was equivalent to what we now call grape syrup.

In Europe physicians often send their patients to the wine-growing districts during vintage time to take daily rations of the fresh juice as it comes from the crusher. This, however, restricts its use to a brief season of the year and to the immediate vicinity of the vineyards, or to individuals who are yet strong enough to undertake the journey. Of late years repeated efforts have been made to prevent the juice from fermenting and to preserve it in vessels of such size and shape as can be easily transported, thus rendering its use possible at all times of the year. Until recently its use has been almost exclusively restricted to juice for medicinal or sacramental purposes. Unrestricted and general use has been retarded through lack of knowledge of the principles underlying the process of manufacture. This lack of knowledge and of the necessary skill in applying it has resulted in many failures, thus rendering the production of a good article uncertain and expensive.

Composition of the Grape

The grape contains 12 to 28 per cent of sugar, about 2 to 3 per cent of nitrogenous substances, and some tartaric and malic acids. The skins contain tannin, cream of tartar, and coloring matter. The seeds contain tannin, starchy matters and fat. The stems contain tannin, diverse acids and mucilaginous matter. The value of the juice made from any grape is determined by the relative proportion and composition of these various parts.

Causes of Fermentation

It is well known that grapes and other fruits when ripe have the invisible spores of various fungi, yeasts (ferments), and bacteria adhering to their skins and stems. When dry these spores are inert, but after the grapes are crushed and the spores are immersed in the juice they become active and begin to multiply. If the juice is warm, the changes take place rapidly; if, on the other hand, it is cool, the change is slower. But in either case, if left alone, the organisms increase until the juice ferments. The most favorable temperature for fermentation is between 65 degrees Fahrenheit and 88 degrees Fahrenheit. Cold checks, but does not kill, the ferment. This fermentation, now commonly called the elliptic yeast, changes the sugar in the grape to alcohol and carbonic-acid gas, and is the leading factor in converting must into wine. Hence it will be readily seen that to keep grape juice sweet fermentation must be prevented, and to

be salable the product must be clear, bright, and attractive.

Methods of Preventing Fermentation

Fermentation may be prevented in either of two ways:

(1) By chemical methods, which consist in the addition of germ poisons or antiseptics, which either kill the germs or prevent their growth. Of these the principal ones used are salicylic, sulphurous, boracic, and benzoic acids, formalin, fluorides, and saccharin. As these substances are generally regarded as adulterants and injurious, their use is not recommended.

(2) Mechanical means are sometimes employed. The germs are either removed by some mechanical means, such as filtering or a centrifugal apparatus, or they are destroyed by heat, electricity, etc. Of these, heat has so far been found the most practical.

When a liquid is heated to a sufficiently high temperature all organisms in it are killed. The degree of heat required, however, differs not only with the particular kind of organism, but also with the liquid in which they are held. Time is also a factor. An organism may not be killed, if heated to a high temperature and quickly cooled. If, however, the temperature is kept at the same high degree for some time, it will be killed. It must also be borne in mind that fungi, including yeasts, exist in the growing and the resting states, the latter being much more resistant than the former. A characteristic of the fungi and their spores is their great resistance to heat when dry. In this state they can be heated to 212 degrees Fahrenheit without being killed. The spores of the common mold are even more resistant. This should be well considered in sterilizing bottles and corks, which should be steamed to 240 degrees Fahrenheit for at least fifteen minutes.

Practical tests so far made indicate that grape juice can be safely sterilized at from 165 degrees Fahrenheit to 176 degrees Fahrenheit At this temperature the flavor is hardly changed, while at a temperature much above 200 degrees Fahrenheit it is. This is an important point, as the flavor and quality of the product depend on it.

This bulletin being intended for the farmer or the housewife only, the writer refers such readers as desire to go into the manufacture of grape juice in a systematic manner for commercial purposes to Bulletin 24, Bureau of Plant Industry, Department of Agriculture, on the same subject, this publication treating only of methods that can be applied in every home.

Home Manufacture

Use only clean, sound, well-ripened but not over-ripe grapes. If an ordinary cider mill is at hand, it may be used for crushing and pressing, or the grapes may be crushed and pressed with the hands. If a light-colored juice is desired, put the crushed grapes in a cleanly washed cloth sack and tie up. Then either hang up securely and twist it or let two persons take hold, one on each end of the sack and twist until the greater part of the juice is expressed. Then gradually heat the juice in a double boiler or a large stone jar in a pan of hot water, so that the juice does not come in direct contact with the fire, at a temperature of 180 degrees Fahrenheit to 200 degrees Fahrenheit; never above 200 degrees Fahrenheit. It is best to use a thermometer, but if there be none at hand heat the juice until it steams, but do not allow it to boil. Put it in a glass or enameled vessel to settle for 24 hours; carefully drain the juice from the sediment, and run it through several thicknesses of clean flannel, or a conic filter made from woolen cloth or felt may be used. This filter is fixed to a hoop of iron, which can be suspended wherever necessary. After this fill into clean bottles. Do not fill entirely, but leave room for the liquid to expand when again heated. Fit a thin board over the bottom of an ordinary wash boiler, set the filled bottles (ordinary glass fruit jars are just as good) in it, fill in with water around the bottles to within about an inch of the tops, and gradually heat until it is about to simmer. Then take the bottles out

and cork or seal immediately. It is a good idea to take the further precaution of sealing the corks over with sealing wax or paraffin to prevent mold germs from entering through the corks Should it be desired to make a red juice, heat the crushed grapes to not above 200 degrees Fahrenheit, strain through a clean cloth or drip bag (no pressure should be used), set away to cool and settle, and proceed the same as with light-colored juice. Many people do not even go to the trouble of letting the juice settle after straining it, but reheat and seal it up immediately, simply setting the vessels away in a cool place in an upright position where they will be undisturbed. The juice is thus allowed to settle, and when wanted for use the clear juice is simply taken off the sediment. Any person familiar with the process of canning fruit can also preserve grape juice, for the principles involved are identical.

One of the leading defects so far found in unfermented juice is that much of it is not clear, a condition which very much detracts from its otherwise attractive appearance and due to two causes already alluded to. Either the final sterilization in bottles has been at a higher temperature than the preceding one, or the juice has not been properly filtered or has not been filtered at all. In other cases the juice has been sterilized at such a high temperature that it has a disagreeable, scorched taste. It should be remembered that attempts to sterilize at a temperature above 195 degrees Fahrenheit are dangerous, so far as the flavor of the finished product is concerned.

Another serious mistake is sometimes made by putting the juice into bottles so large that much of it becomes spoiled before it is used after the bottles are opened. Unfermented grape juice properly made and bottled will keep indefinitely, if it is not exposed to the atmosphere or mold germs; but when a bottle is once opened it should, like canned goods, be used as soon as possible, to keep it from spoiling.

Manufacture of Larger Quantities

Another method of making unfermented grape juice, which is often resorted to where a sufficiently large quantity is made at one time, consists in this:

Take a clean keg or barrel (one that has previously been made sweet). Lay this upon a skid consisting of two scantlings or pieces of timber of perhaps 20 feet long, in such a manner as to make a runway. Then take a sulphur match, made by dipping strips of clean muslin about 1 inch wide and 10 inches long into melted brimstone, cool it and attach it to a piece of wire fastened in the lower end of a bung and bent over at the end, so as to form a hook. Light the match and by means of the wire suspend it in the barrel, bung the barrel up tight, and allow it to burn as long as it will. Repeat this until fresh sulphur matches will no longer burn in the barrel.

Then take enough fresh grape juice to fill the barrel one-third full, bung up tight, and roll and agitate violently on the skid for a few minutes. Then burn more sulphur matches in it until no more will burn; fill in more juice until the barrel is about two-thirds full; agitate and roll again. Repeat the burning process as before, after which fill the barrel completely with grape juice and roll. The barrel should then be bunged tightly and stored in a cool place with the bung up, and so secured that the package can not be shaken. In the course of a few weeks the juice will have become clear and can then be racked off and filled into bottles or jars direct, sterilized, and corked or sealed up ready for use. By this method, however, unless skillfully handled, the juice is apt to have a slight taste of the sulphur.

A Few Useful Appliances

An ordinary cider press is not expensive; nevertheless the majority of farms do not have one, and it frequently occurs that a farm is located so far away from any establishment dealing in such implements that the fruit might spoil or not be sufficiently valuable to justify the purchase price and time lost and expense incurred in getting it. A very efficient lever press for this and similar uses can be made by any farmer handy with tools. The material can be found

on almost any farm at any time. The press consists of the following parts:

Two upright posts set deep and firmly in the ground side by side and about 12 inches apart. (It is a good idea to attach some deadmen to them in the ground to prevent them pulling out too easily.) Between these posts the lever is hung by means of a bolt, or the lever may be hung to the side of a building, or a hole notched into a tree large enough to admit the end of the lever and a bolt run through that. At the other end of the lever are two posts, so set that the lever can be raised up between them by means of block and tackle. The press itself consists of two timbers on which the press bottom rests, and on this bottom is the press basket, consisting of the two sides and two ends, and so constructed that it can be easily taken apart and set up again, being held together at the ends by means of rods. The sides and ends should be bored full of small holes from three-eighths to one-half inch in diameter to allow exit for the juice.

After the press is filled, the top (which is made to fit in the inside of the basket) and cross blocks are put on and the lever is then allowed to press down on it. A press like this has the advantage that it can be filled in the evening and left to press until morning while the farmer sleeps. The precaution, of course, must be taken to set a tub large enough to hold the juice under the press.

It is perhaps well to state that the longer and heavier the lever the greater the pressure it exerts. Where it is not convenient to make the lever very long, weights are placed or hung on the outer extremity of the lever to increase the pressure. It will thus be seen that with a little ingenuity a person can adapt the press to suit his individual requirements.

For ordinary purposes a press basket 3 feet square and 2 feet high will be found a very convenient size. This will accommodate a ton of crushed grapes.

Composition of Unfermented Grape Juice

Herewith are given the component parts of a California and a Concord unfermented grape juice, the former being analyzed by the California Experiment Station, the latter by the Bureau of Chemistry, United States Department of Agriculture:

	Concord	California
	Per cent	Per cent
Solid contents... ..	20.37	20.60
Total acids (as tartaric)	.663	.53
Volatile acids....... .	.023	.03
Grape Sugar . ..	18 54	19.15
Free tartaric acids.....	.025	.07
Ash	.255	.19
Phosphoric acids..... .	.027	.04
Cream of tartar.......	.55	.59

This table is interesting in so far that California unfermented grape juices are made from *Viniferas* or foreign varieties, whereas the Concord is a *Labruska* or one of our American sorts. The difference in taste and smell is even more pronounced than the analysis would indicate.

Flavor and Quality in Grape Juice

In the making of unfermented grape juice a great deal of judgment can be displayed and many variations produced so as to suit almost any taste by the careful selection of the varieties of grapes from which it is made. From the Mission grape, for instance, when fully ripe, a juice would be obtained that would be delicate and simply sweet, without any other taste; from the Muscat we would get that rich musky flavor found in our leading raisins; in the Concord that sprightly foxy taste so well known; in the Catawba or Isabella that fragrance so peculiarly their own, and in the Iona a pleasing, mild, yet just pronounced enough aroma and taste to strike the right spot. Thus we might continue along the list.

Equally as pronounced variations in color can be had, as, for instance, almost colorless, yellow, orange, light red, red, and a deep purple.

The writer has often been asked what kind of grapes should be used in making unfermented grape juice, when, as a mat-

ter of fact, it can be made from any grape, not only this, but unfermented juice is made from other fruits as well, for instance, apples, pears, cherries—and berries of different kinds yield excellent juices. It is really good judgment in selecting the right varieties when planting for fruit production That also determines the quality of our unfermented juice For instance, the richer, sweeter, and better in quality the fruit we use, the richer, sweeter, and better will be our unfermented juice. If, on the other hand, the fruit is sour, green, and insipid, the juice will be likewise. As stated before, the intention of this bulletin is to show how to avoid some wastes, and to increase income by utilizing those products of which there is a surplus; and instead of, as is usually done, letting them rot, convert them into something that can be kept, used, and disposed of at any time when desired, or when fresh fruit is not available.

Uses of Unfermented Grape Juice

The uses are indeed many. It is used in sickness, convalescence, and good health; as a preventive, restorative, and cure; by the young, by persons in the prime of life, and by those in old age. It is used in churches for sacramental purposes; at soda fountains as a cool and refreshing drink; in homes, at hotels, and at restaurants as a food, as a beverage, as a dessert, and in many other ways. When people become accustomed to it they rarely give it up. When properly prepared, unfermented grape juice can be made to please the eye by its color and attractive appearance, the sense of smell by its aroma or fragrance, the palate by its pleasant flavor

It is food and drink, refreshment and nourishment, all in one Not a by-product, but made from fruit going to waste —one of the blessings given us, that some are too careless, others too ignorant, to make use of.

Food Value of Unfermented Grape Juice

The effects of unfermented grape juice on the human system have been studied for a number of years, especially at the so-called grape cures so long in vogue in Europe. A smaller number of investigations have been made in laboratories.

It is quite generally claimed that using a reasonably large amount of unfermented grape juice with an otherwise suitable mixed diet is beneficial and that digestion is improved, intestinal fermentation diminished, and that gains in body weight result. It should not be forgotten that the abundant diet and hygienic methods of living practiced at the grape cures play an important part, but even taking all this into account it seems fair to conclude that some of the good results can be directly attributed to the unfermented grape juice

Grape juice contains the same kinds of nutrients as other foods. The percentage of water is high, and thus it resembles liquid foods more closely than solid foods. It is sometimes compared with milk, the most common liquid food. It contains less water than milk, more carbohydrates, and less protein, fat, and ash. Carbohydrates, largely present in the form of sugar, are the principal nutritive ingredients. It is evident, therefore, that grape juice is essentially an energy yielding food, and may help the body to become fatter, though it can not materially assist in building nitrogenous tissue. Sugars in moderate amounts are wholesome foods, and grape juice offers such material in a reasonably dilute as well as palatable form. Undoubtedly the agreeable flavor increases the appetite, a by no means unimportant consideration.

A FEW GOOD RECIPES

Grape Nectar

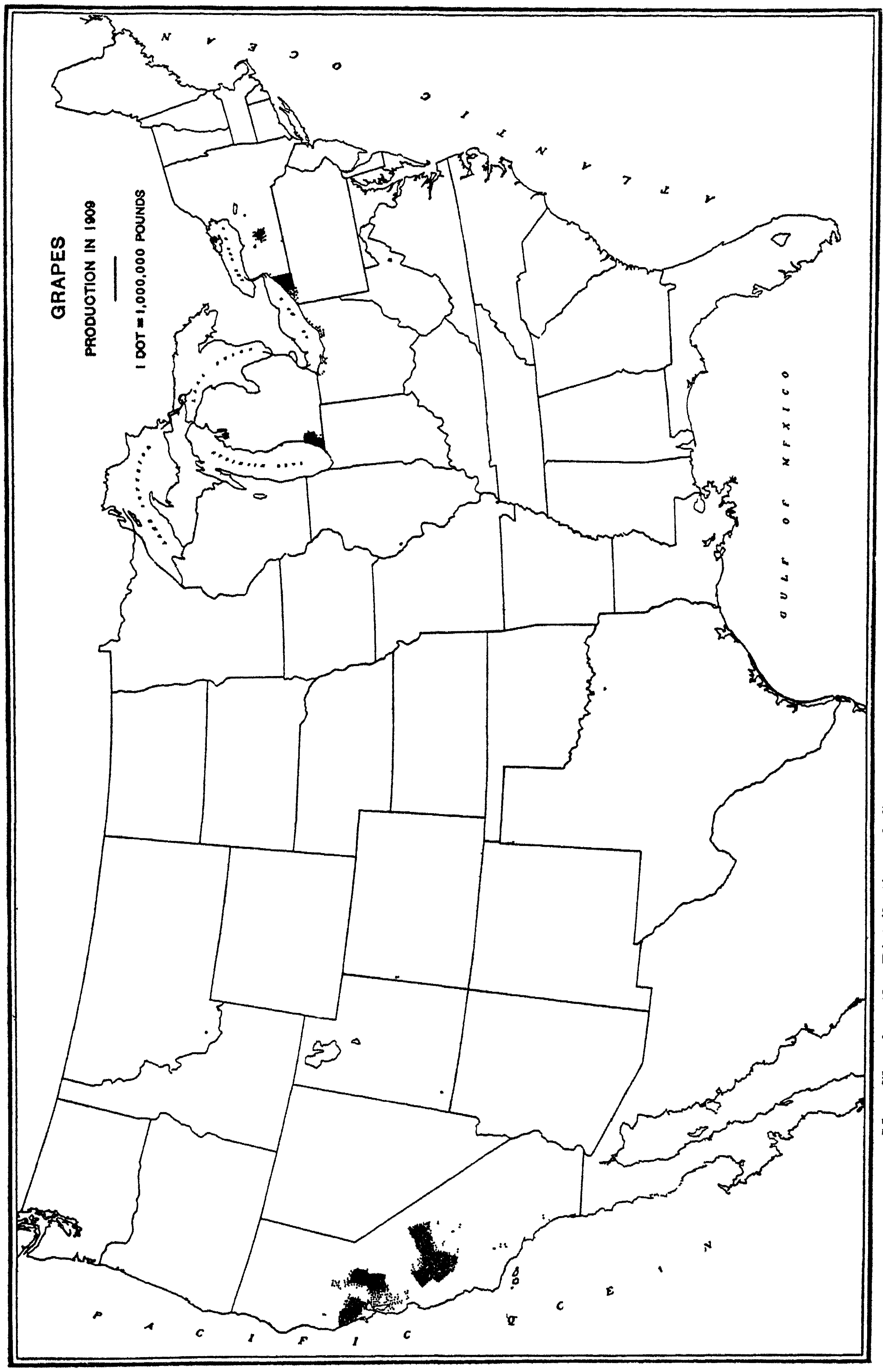
Take the juice of two lemons and one orange, one pint of grape juice, one small cup of sugar, and a pint of water. Serve ice cold. If served from punch bowl, sliced lemon and orange add to the appearance.

An Invalid Drink

Put in the bottom of a wineglass two tablespoonfuls of grape juice; add to this the beaten white of one egg and a little chopped ice; sprinkle sugar over the top and serve. This is often served in sanitariums.

Thirteenth Census of the United States: 1910.

Department of Commerce, Bureau of the Census



Map Showing the Distribution of Grape Production in the United States and Relative Quantity Produced in Each Section.

Grape Punch

Boil together one pound of sugar and half a pint of water until it spins a thread; take from the fire and when cool add the juice of six lemons and a quart of grape juice. Stand aside overnight. Serve with plain water, apollinaris, or soda water.

Grape Sherbet

For eight persons mix one pint of grape juice (unfermented), juice of lemon, and one heaping tablespoonful of gelatine, dissolved in boiling water; freeze quickly; add beaten white of one egg just before finish.

Grape Ice Cream

One quart of unfermented grape juice, one quart of cream, one pound of sugar, and the juice of one lemon.

Syllabub

One quart of fresh cream, whites of four eggs, one glass of grape juice, two small cups of powdered sugar; whip half the sugar with the cream, the balance with the eggs; mix well; add grape juice and pour over sweetened strawberries and pineapples, or oranges and bananas. Serve cold.

Bohemian Cream

One pint thick cream, one pint grape juice jelly; stir together; put in cups and set on ice. Serve with lady fingers.

Besides the recipes just given many more are enumerated, such as grape ice, grape lemonade, grape water ice, grape juice and egg, baked bananas, snow pudding, grape gelatine, junket and grape jelly, tutti-frutti jelly, grape float, grape jelly, grape juice plain, grape soda water, and scores of others.

GEORGE C. HUSSMAN,
Expert in charge of Viticultural Investigations, Bureau of Plant Industry, United States Department of Agriculture, Washington, D. C.

Grapes in the United States

Number of bearing grape vines in the United States according to the census of 1910.

California, 144,097,670.
New York, 31,802,097.
Michigan, 11,013,576.
Ohio, 8,326,800.
Pennsylvania, 5,271,261.
Missouri, 3,026,526.
Kansas, 2,889,845.
Oklahoma, 2,388,213.
Illinois, 2,170,340.
Iowa, 1,983,465.
New Jersey, 1,603,282.
Nebraska, 1,221,736.
Indiana, 1,049,232.
Arkansas, 805,921.
Texas, 712,201.
Kentucky, 605,002.
Virginia, 424,601.
Oregon, 381,302.
Tennessee, 338,758.
Washington, 322,007.
Alabama, 287,431.
West Virginia, 284,074.
Georgia, 277,658.
Delaware, 260,936.
Colorado, 254,292.
New Mexico, 250,076.
Utah, 204,445.
Wisconsin, 148,348.
Maryland, 138,801.
Arizona, 131,579.
Connecticut, 107,054.
South Carolina, 79,708.
Mississippi, 77,012.
Idaho, 68,269.
Minnesota, 61,916.
Massachusetts, 58,277.
South Dakota, 38,647.
Louisiana, 31,041.
Florida, 20,962.
Maine, 9,731.
Vermont, 9,318.
Rhode Island, 7,662.
North Carolina, 1,955.
Montana, 986.
New Hampshire, 759.
North Dakota, 379.
Wyoming, 74.
Nevada, 2.

Production and Value of Grape Vines in the United States

Division or State	Number of Vines of bearing age 1910	Number of Vines not of bearing age 1910	Production (pounds)		Value	
			1909	1899	1909	1899*
U. S....	**223,701,522**	**59,928,644**	**2,571,065,205**	**1,300,984,097**	**$22,027,961**	**$14,090,234**
Geog. Divs..						
New Eng..	207,844	92,370	3,413,161	4,324,300	$ 108,348	$ 112,614
Mid. Atl..	38,676,641	12,613,556	293,527,780	299,058,493	4,945,342	3,484,987
E. N. C...	22,708,296	2,825,671	194,730,671	159,936,481	3,129,363	2,244,659
W. N. C..	9,222,514	1,740,265	41,088,852	40,735,442	1,156,625	870,382
S. Atl....	1,903,341	543,306	32,439,760	34,579,571	909,900	721,124
E. S. C...	1,308,203	265,641	8,143,715	14.817,562	348,397	356,687
W. S. C...	3,937,376	943 918	8,265,667	14,228,318	304,454	371,965
Mountain.	936,328	537,267	4,858,195	5,286,730	128,532	115,206
Pacific....	144,800,979	40,366,650	1,984,597,404	728,017,200	10,997,000	5,812,610

*Includes value of wine, grape juice, raisins, etc.

Area of Vineyards and Production of Wine in Specified Countries, 1912-1911

(From a report of the International Institute of Agriculture)

Country	Area		Production (wine)	
	1912	1911	1912	1911
	Acres	Acres	Gallons	Gallons
Spain....................	3,123,356	3,187,533	369,838,000	389,572,846
France..................	4,148,663	4,156,501	1,567,559,288	1,185,740,254
Italy.....................	11,008,305	11,063,161	1,162,348,000	1,126,793,360
Luxemburg...............	3,830	3,618	1,074,379	3,614,797
Roumania................	174,030	176,523	33,021,250	26,243,625
Switzerland..............	58,563	58,563	23,854,551	22,580,459

—Crop Reporter, January, 1913

RAISINS

Exports of Raisins—Years Ending June 30, 1906-1910

Exported to	1906	1907	1908	1909	1910	Exported to	1906	1907	1908	1909	1910
	Pounds	Pounds	Pounds	Pounds	Pounds		Dollars	Dollars	Dollars	Dollars	Dollars
Europe	42,420	847,843	57,780	100,080	46,231	Europe	2,888	55,638	3,548	8,018	3,249
North America	3,179,755	6,783,206	4,172,487	6,374,222	6,739,942	North America	208,057	436,434	301,433	356,265	318,789
South America	42,979	53,201	41,923	32,253	63,602	South America	3,540	4,855	4,016	2,879	5,158
Asia	234,025	215,250	172,264	201,756	221,235	Asia	18,532	18,346	14,920	14,096	13,812
Oceania	1,014,947	1,215,030	1,235,587	1,165,954	1,443,852	Oceania	71,475	82,698	103,183	73,890	75,517
Africa	14,376	14,297	4,500	5,896	11,252	Africa	1,276	1,427	483	509	878

Imports of Raisins—Years Ending June 30, 1906-1910

Imported from	1906	1907	1908	1909	1910	Imported from	1906	1907	1908	1909	1910
	Pounds	Pounds	Pounds	Pounds	Pounds		Dollars	Dollars	Dollars	Dollars	Dollars
Europe	4,949,802	2,623,641	7,384,455	3,033,794	2,792,262	Europe	280,399	272,609	423,771	191,788	221,520
North America	90,974	215	24,390	140	361	North America	2,883	24	2,435	8	21
South America	150	....	138	....	....	South America	11	....	8	....	....
Asia	7,373,929	1,342,035	1,723,370	2,760,386	2,250,060	Asia	241,297	91,684	128,419	135,848	74,506
Africa	....	1,260	....	....	....	Africa	....	86	....	....	....

Imports of Grapes—Years Ending June 30, 1906-1910

Grapes (Dutiable) *

Imported from	1906	1907	1908	1909	1910	Imported from	1906	1907	1908	1909	1910
	Cubic feet	Cubic feet	Cubic feet	Cubic feet	Cubic feet		Dollars	Dollars	Dollars	Dollars	Dollars
Europe	....	1,296,808	2,226,513	1,199,392	1,361,688	Europe	....	1,574,068	2,735.802	1,572,158	1,680,047
North America	....	1,626	7,995	4,024	3,497	North America	....	1,418	7,554	3,451	2,836
South America	....	....	....	3	....	South America	....	....	....	11	....
Asia	....	....	....	....	125	Asia	....	....	....	....	111
Oceania	....	35	....	....	....	Oceania	....	35	....	....	....

* Included in "All other fruits," dutiable, prior to 1907.

Thompson Seedless Grape used for Seedless Raisin.

FORMULA FOR CARLOAD GRAPE LOADING

The measurements of a grape crate packed and ready for shipment are as follows:

Length,	Outside	17½ inches
Width,	"	16½ "
Depth,	"	6 "

The inside measurements of a Pacific Fruit Express refrigerator car are as follows:

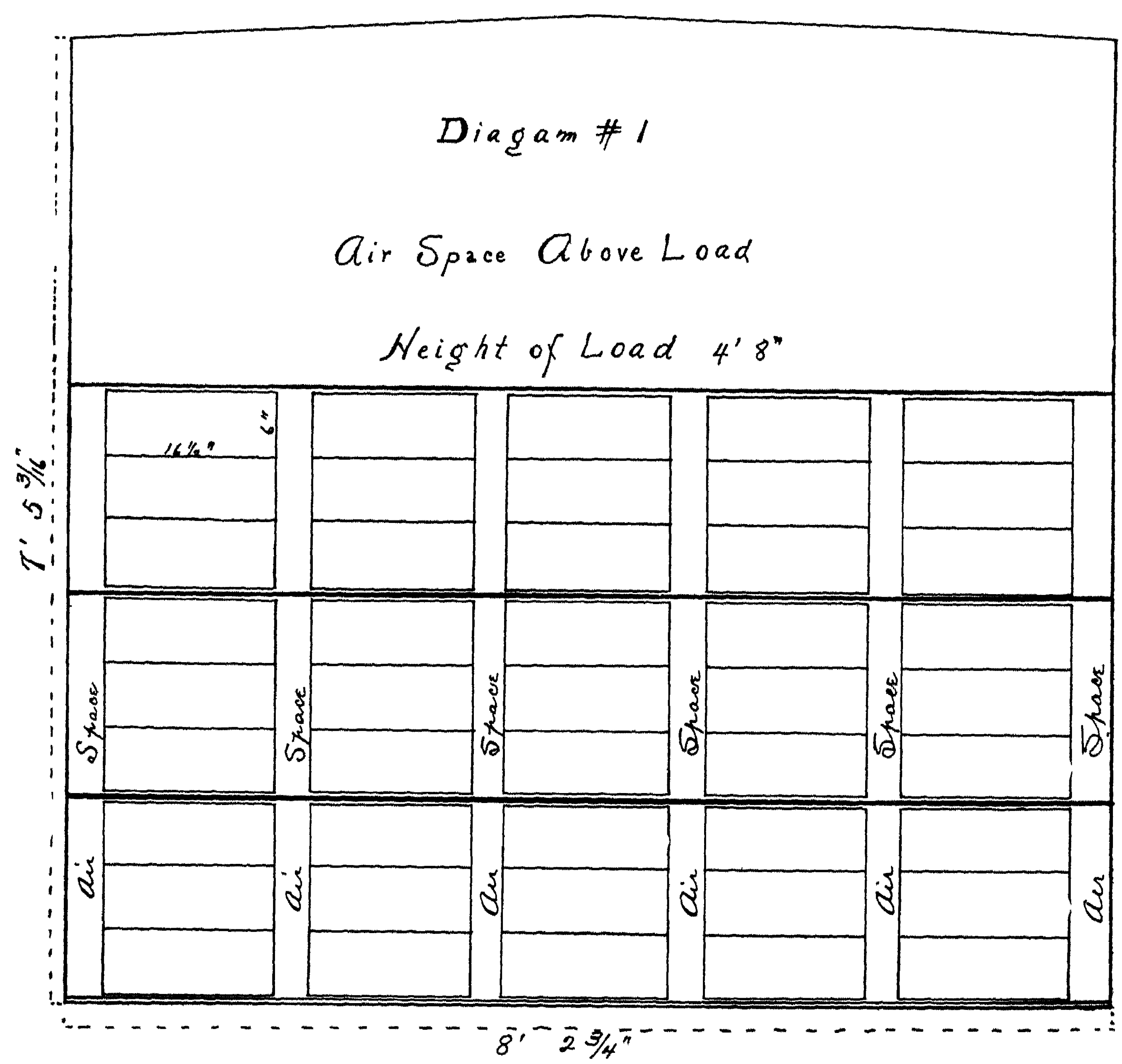
Length	33 ft. 2¾ in.
Width	8 ft. 2¾ in.
Height	7 ft. 5 3/16 in.

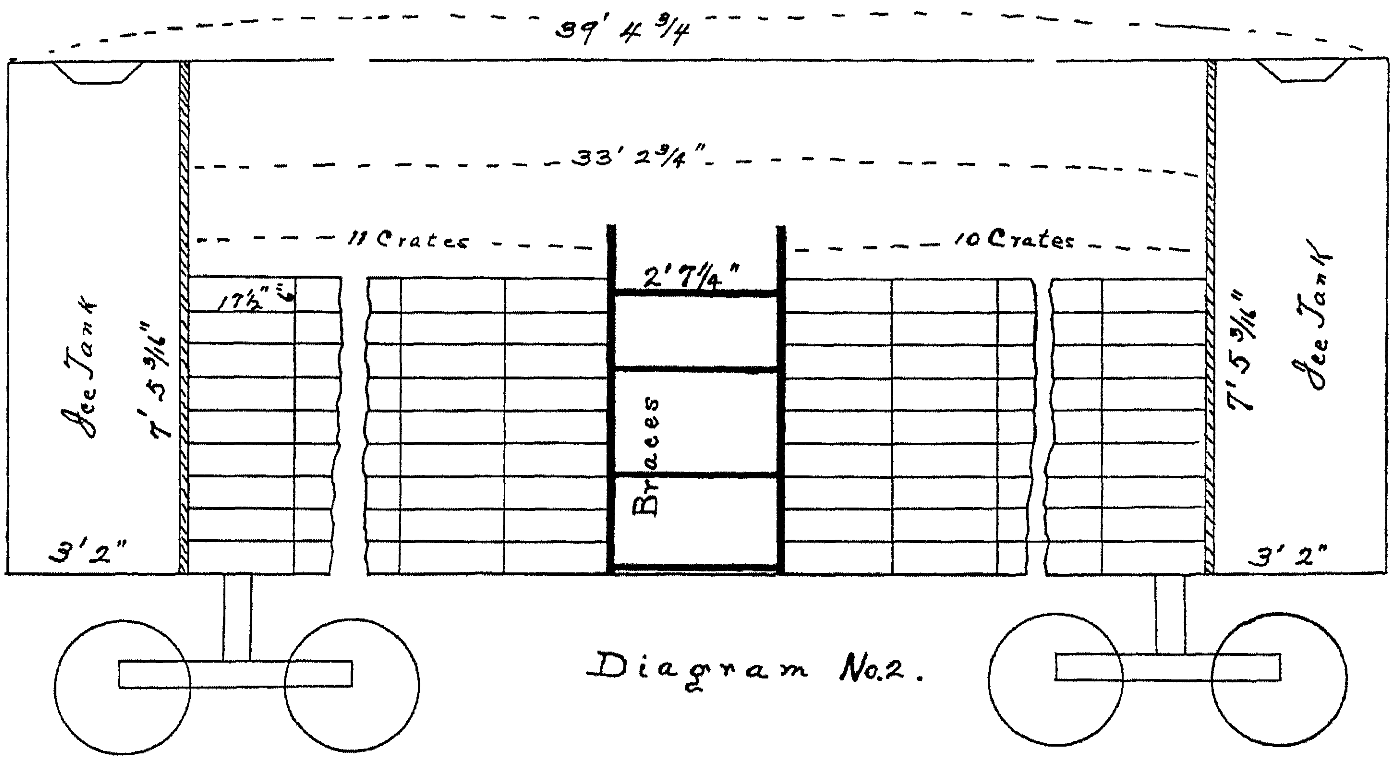
The carload minimum weight on grapes from California to Eastern points is 26,000 lbs.

The standard formula for loading generally used is to load 945 crates per car in tiers of five crates wide and nine crates high across the width of the car, as per diagram No. 1, and 21 tiers lengthwise of the car with 11 tiers on one side and 10 tiers on the other side of the doorway, as per diagram No. 2.

The crates are loaded lengthwise with the end showing marks or labels towards the doorway, and each tier is braced by means of car strips ⅜ inch thick, 1 inch wide and 8 feet long, as follows:

Two car strips are first placed 15½ inches apart across the car floor with end of one of the strips against each side of the car and crates are then placed on top of the strips with an additional set of strips used between every third row and on top, making four sets of strips to each tier as indicated by heavy lines in diagram No. 1. Each set of strips is securely nailed to the end of the crates except the strips on the car floor which are held in place by the weight of the tier. These strips keep the crates in





place and each tier throughout the car is braced in the same manner.

After load is completed the space left in the doorway for bracing measures 2 feet 7¼ inches and is braced by means of gate braces constructed of 2x4-inch material, as follows:

Each gate consists of two uprights 5 feet 4 inches long and four cross pieces, about 2 feet 4 inches long, built in between each row, making five gates in the center bracing as indicated by heavy lines in diagram No. 2. The uprights are first put in and cross pieces cut from ½ inch to 1 inch longer than the exact measurement and wedged in so as to take up any slack and keep the load from shifting. Cross pieces are first put in between the uprights on the car floor and securely toenailed to the car floor and the uprights with additional cross pieces about 14 inches apart and securely nailed to the uprights. After all the gates have been completed car strips are nailed to the uprights on each side of the brace, on top of the lower cross piece and under each of the other cross pieces, thereby preventing gates from shifting sideways and making a solid load.

H. E. Cole

GRAPE DISEASES

Anaheim Diseases. See *Miscellaneous Diseases*, this section.

Anthracnose

Sphaceloma ampelinum De By.

Anthracnose has also been called "bird's-eye rot," on account of the peculiar spots it produces upon affected grapes. Like most of the other diseases of the grape, it attacks the leaves and shoots as well as the fruit. On the leaves it at first appears as minute, irregular, dark brown, slightly sunken spots, having a darker margin. These spots usually become lighter colored when old, and frequently crack or fall out, leaving irregular holes in the leaves. This disease presents much the same appearance on the shoots as on the leaves, though the spots are frequently larger and more sunken. They also tend to run together and form irregular patches.

The disease is most characteristic and conspicuous upon the fruit. The spots are usually brown at first and surrounded by a narrow, dark purplish margin; they increase in size and gradually become grayish white and somewhat sunken. Frequently two or more spots unite and cover a considerable part of the berry. The fruit becomes hard and more or less wrinkled. If only a small part

of the berry is affected it may continue to grow, causing the diseased area to rupture and the seeds to become exposed. The bursting of the berries and the exposure of the seeds may, however, be produced by other causes, such as the powdery mildew and certain physiological disturbances.

On the diseased areas the minute spores or germs of the fungus are frequently produced in immense numbers. The fine, thread-like filaments which constitute the vegetative part of the parasite live during the winter in the tissues of the vines and are ready for active growth in the spring.

The anthracnose is quite widely distributed in this country, but fortunately has not caused any great general loss. Its eradication is difficult, however, once it is well established.

Treatment

Diseased shoots should be cut and burned. The spraying program for black rot will usually control this disease, in connection with the cutting out of affected shoots, except where unusually severe, in which case the sulphate of iron solution is used in the following formula:

Sulphate of iron, 110 pounds; sulphuric acid, 1 quart; hot water, 26 gallons.

First pour the acid upon the sulphate of iron, then add the water. Care should be used in handling, as the preparation will injure skin and clothing. Apply thoroughly just before the buds begin to swell in the spring.

Reference

United States Department of Agriculture Farmers' Bulletin 284.

Bitter Rot

Melanconium fuligineum

Resembles ripe rot. Is restricted to the Southern states.

The black rot treatment will control it.

Black Knot

Bacterium tumefaciens

*This is one of the commonest and most widely distributed diseases of the vine. It consists of peculiar growths, or swellings, usually near the surface of the ground on the upper parts of the roots or the lower part of the trunk. It often occurs, also, on all parts of the trunk and branches, but only rarely on the canes.

As a rule it does little damage unless it occurs on young vines, or attacks old vines very severely.

In some cases where the knots occur on a branch or arm they could be removed and the vine might recover perfectly.

It is not uncommon to find vines with large masses of knots on all sides of the trunk and on all the arms, which yet make a vigorous growth and produce good crops. When the knots extend all around the trunk of an old vine, however, it may be girdled, and, while it seldom dies, it may become weak and worthless.

The knots appear only on vines growing in moist places, and especially in sandy soil in the hotter regions.

It is now known to be due to an infection by the crown-gall organism, *Bacterium tumefaciens.*

Anything which causes a vine to grow vigorously late in the season and prevents the proper ripening of the wood, renders it susceptible to the disease.

In accordance with these ideas, the remedies advocated aim at causing the vine to ripen its wood early and completely. These remedies are drainage of the soil, fertilization with phosphatic manures, longer pruning, raising the trunk of the vine, and removal of the knots. Swabbing with lime, sulfate of iron, and other antiseptics has proven useless.

See *Crown Gall* under *Apple Diseases.*

Black Rot

Guignardia bidwellii (Ell.) V. & R.

Black rot is the most generally distributed and destructive fungous disease of the grape in the region east of the Rocky mountains. It gains entrance to the plant by means of minute germs called spores. These are borne in small black spore cases, and can not be seen with the naked eye. They are distributed

* California Experiment Station Bulletin 197.

chiefly by the wind and rain. When these spores come in contact with the young and tender parts of the vine, under favorable conditions, they germinate and produce a slender tube, which penetrates the tissue and may destroy it.

This disease attacks the leaves and shoots, as well as the fruit. It usually makes its first appearance on the leaves and young shoots, producing reddish-brown dead spots. The fruit may be attacked when young, but usually the disease does not attract attention until the berries are half grown or more. Brown or blackish spots first appear; these spread and soon affect the whole berry, which becomes black and shriveled. These diseased berries remain attached to the vine, and their surfaces become covered with minute black pustules, which contain the summer spores of the fungus. During the winter and spring another form, called the winter, or resting spore, is produced upon these old, shriveled berries. These spores help to carry the disease over from one season to another. This fact would indicate the desirability of destroying, by burning, all diseased fruit, as well as leaves and prunings, as early in the spring as possible.

Treatment

This disease can be effectually controlled by thorough spraying with Bordeaux mixture (4-3-50 formula). Five or six applications are usually necessary during the season, the first being made when the shoots are eight inches long. For the last one or two applications, some fungicide which does not stain the fruit should be used. Neutral copper acetate, one pound to 50 gallons of water, has been found the best non-staining preparation. The spray should be put on by nozzles giving a fine spray and directed by hand so as to cover all leaves and fruit.

References

Farmers' Bulletin 284.
Bureau of Plant Industry Bulletin 155.
Cornell Bulletin 253.
Cornell Bulletin 266.
Cornell Bulletin 293.

Colure or Dropping

The raisin grape, Muscat of Alexandria, is subject to a blossom drop without setting of fruit.

Failure of the blossoms to pollinate properly is assigned as the cause.

The remedy is to plant occasional rows of other varieties such as Palomino, Perruno, Beba and Berger.

Reference

California Experiment Station Bulletin 197.

Brown Rot. See *Downy Mildew*, this section.

California Vine Disease. See *Miscellaneous Diseases*, this section.

Downy Mildew

Plasmopara viticola
(B. & C.) Berl. & De Toni

Downy mildew in certain seasons and in northern localities east of the Rockies sometimes causes more loss than black rot and is a close rival for first place among the fungous enemies of the grape. It attacks all the tender growing parts of the vine. Usually it is at first most noticeable on the foliage, producing greenish-yellow, irregular spots upon the upper surface, which become reddish brown. At the same time there appears on the under surface of the leaf a thin, loose, white, downy growth, suggestive of hoar frost. This growth consists of the fertile fungous filaments bearing the summer spores, which under favorable conditions are distributed by the wind and water to the berries and other parts, where they germinate, penetrate the tissues, and continue their destructive work. The young shoots are also frequently attacked and killed.

The fruit, if attacked when young or only partly grown, shows first a brownish spot, and later becomes covered with the gray, downy growth of the fungus. This form of the disease is sometimes called "gray rot" by vineyardists. When the berries escape the disease until they are half grown or more it appears as a brownish or brownish-purple spot which spreads and soon involves the whole berry. The affected fruit becomes soft and wrinkled and falls to the ground when

disturbed. This stage of the disease is sometimes called "brown rot."

Besides the summer spores mentioned, there is also produced within the diseased tissues another form of reproductive body, sometimes called a winter, or resting spore. These spores are produced in much smaller numbers than the summer spores and are provided with a rather thick, dark-colored outer covering apparently intended for their protection during the winter.

This disease, like the black rot and many others, develops most rapidly and does most injury during hot, wet weather

Treatment

It is desirable to destroy as many as possible of the diseased leaves, shoots, and berries, which may contain the winter spores. Thorough spraying, as recommended for the black rot, will effectually control this disease.

References

United States Department of Agriculture Farmers' Bulletin 284.

Connecticut Experiment Station Bulletin 56.

LITTLE LEAF. See *Miscellaneous Diseases*, this section.

Powdery Mildew
Uncinula spiralis

The only important fungous disease that is of special interest to grape growers in the Northwest at the present time is the disease known as the powdery mildew. This is most serious on the European varieties and consequently is of special interest in California and those sections where these varieties are grown.

Symptoms

The disease may attack any herbaceous part of the vine. On the leaves the fungus appears in the form of white or greenish-white patches of mildew These may run together till the greater part of the leaf is covered. The fungus may also attack the young canes, beginning at the base in the form of small patches; or in severe cases the whole surface may be covered. The green or white mildew is easily rubbed off, leaving on the canes brownish spots which soon turn black. If severely attacked the canes fail to grow or mature properly. When the disease attacks the blossoms they fail to set. If the young fruit is attacked when quite small the berries may drop off. If attacked when half grown they develop irregularly and the affected parts become hardened, the ripe berries becoming irregular in form. If severely affected they may crack, thus becoming useless for table or market use. If this cracking is early they may still be used for wine, though in moist seasons they may be attacked by various molds. The berries are usually not attacked after they begin to ripen. When only slightly affected the berries may ripen without cracking, but are disfigured by spots or blotches which reduce their value for market purposes.

Cause

The cause is a fungus known technically as *Uncinula spiralis*. This, like all fungi commonly known as powdery mildews, grows more or less superficially on the surface of the affected parts. The fine thread-like mycelium is largely external, sending short feeding branches into the epidermal cells of the host. From this superficial mycelium erect branches are formed which break down into short cells or spores. When abundant these give the spots the powdery appearance that accounts for the popular name of this and other related forms. These spores are spread by the wind and thus may come to rest on a healthy part of a vine. They germinate by putting out a thread of mycelium which branches and attaches itself to the surface of the host and grows into a fungous plant which, when it has reached its full development, produces spores in countless numbers like that from which it grew. This stage, which is known as the summer spore stage, serves to spread the fungus rapidly.

Later in the season another form of the fungus, sometimes spoken of as the winter or resting stage, is produced. This form gives rise to spores borne in tiny sacks in receptacles which protect them until spring, when they are set free

It is from the germination of these

spores on the vines that the first new infections of the summer spore stage start in the spring.

Treatment

Where this disease is serious enough to cause any amount of loss the vines must be protected by some fungicide. It has been found that the best method is to dust the plants with dry sulphur. The fungicidal value of dry sulphur rests largely in the vapors which are given off during hot weather (above 75 degrees) Below this temperature the fungus does not grow well. If the vines are covered with a sulphur dust and the temperature rises above 75 degrees F., the sulphur is volatilized and prevents the growth of the fungus.

The vines may be dusted either when dry or wet with dew. They should not, however, be very wet An application should always be made when the blossoms begin to open. In some sections this is sufficient; in others, a previous application when the vines are about six to eight inches long should be made. Sometimes three or four dustings are necessary. The vines should be carefully watched and when any signs of mildew are detected an application of the sulphur dust should be given to prevent its spread.

Any method of application by which the herbaceous parts of the vine are completely covered with a very fine coating of sulphur dust may be used. The most efficient method is by the use of some form of hand or knapsack duster, several forms of which are good. The best are of European manufacture.

Mr. A. H. Carson, Commissioner of the Oregon State Board of Horticulture and a prominent grape grower at Grants Pass, in a letter dated Sept. 17, 1912, gives the following information concerning his experience in regard to the control of powdery mildew under Oregon conditions:

"For controlling the mildew, we use the best brand of fine sublimed sulphur. The first sulphuring is done when the grapes first bloom. It is important to sulphur at this time, as there is an invisible mildew that attacks the bloom, and if sulphured at this time the grapes will set much heavier than if not sulphured. The vines should again be sulphured when the grapes have formed about the size of a BB shot. If the season is normal, not too much rain, it will not be necessary to sulphur again until the grapes begin to show color, then a third sulphuring should be done.

"No grape grower need fear the mildew if sulphur is used at the time of growth as I have indicated above. Sulphuring the vines as I have indicated is a sure preventive of the mildew, but, should the mildew develop among any of the vines before sulphuring, you cannot stop it on the vines that it has developed on, but you can prevent it spreading to healthy vines. The best sulphuring machine I know of is the Torpille Vermorel, made in France, H. C. Shaw Co., Stockton, California, sole agents for the United States. The machine costs $15 f. o. b. Stockton. One man with this machine can sulphur from 10 to 12 acres in 10 hours. For a small vineyard, sulphur shaken on the vines from a gunny-sack will give results."

H. S. Jackson

Crown Gall. See under *Apple Diseases*.
Red Leaf. See *Miscellaneous Diseases*, this section.

Ripe Rot

Glomerella rufomaculans Berk. Spauld. & von Schrenk

Ripe rot has also been called bitter rot. The name bitter rot is, however, applied to another fungous disease of the grape. As the present name indicates the disease usually appears on the fruit when the latter is nearly mature, and under favorable conditions continues its development and destruction after the grapes are picked. It also attacks the leaves and stems, but is most noticeable and injurious on the fruit The first indication of the disease is the appearance of reddish-brown discolored spots which spread and finally extend over the whole fruit. The surface then becomes dotted with dark, slightly elevated pustules, in which the spores are borne. At this stage of development this disease is not easily distinguished from the early stages of black rot and bitter rot. The berries do

not shrivel up, however, as in the case of the black rot, and usually are easily detached from the bunch. The spores mentioned are produced in large numbers and serve to spread the disease.

The fungus causing this disease is closely related to that which produces the bitter rot of the apple.

It is difficult to determine how much injury is done by this disease on account of the liability of confusing it with other fungous troubles. It is quite generally distributed, and may cause more loss than is usually attributed to it.

Treatment

Spraying as recommended for black rot will largely prevent this disease The later applications are especially important and should be very thorough.

Root Rot

The roots of the grape are known to be attacked by several different fungi, especially when the root system has become weakened or injured by other causes. Three forms of root rot are of sufficient importance to be mentioned here.

Vibrissea Hyprogaea

This fungus is usually associated with insect injury, caused either by *Phylloxera* or by the grape root worm. It has been found in New York, Pennsylvania, and Missouri, and appears to hasten the death of plants, especially those on which the root worm has been at work.

Treatment

This root rot can be prevented only by the destruction of the insects which injure the root system and thus give the fungus opportunity to gain a foothold.

Ozonium

There is a root rot of a more serious nature prevalent in and chiefly restricted to Texas and New Mexico. This is caused by a fungus known as *Ozonium*, which also attacks the roots of cotton and a great variety of other plants. It is most destructive in the black waxy, clay soils, which are very poorly aerated. Plants attacked die suddenly, the leaves and fruit withering up in a day or two and remaining on the vines.

Treatment

No remedy is known for this root rot of the grape. Soil upon which other plants have died with the same disease should be carefully avoided in planting vines.

Armillaria Mellea. For description of this disease see ROOT ROT, under *Apple Diseases.*

References

U. S. Department of Agriculture Farmers' Bulletin 284.

Duggar. Fungus Diseases of Plants.

ROUGEOT. See *Miscellaneous Diseases*, this section.

Shelling

The shelling or dropping of grapes from the bunches before maturity may be due to various causes. In some localities in New York and Pennsylvania this trouble is rather serious. The cases which have been studied have been found to be due mostly to an imperfectly known fungous disease, which appears to be induced chiefly by improper pruning and training Allowing the vines to produce too heavy crops is also likely to increase this trouble.

Stem Cankers

These are caused in many cases by freezes which cause dead spots, which become enlarged in healing.

Drain the soil and prevent late growth.

White Rot

Coniotherium diplodiella

The appearance of this disease is similar to the later stage of the downy mildew. Occurs in the Southwest and Ohio.

It may be controlled by the same means as black rot

MISCELLANEOUS DISEASES

There seem to be a number of troubles of the grape, at present little understood, which have attacked the vines in California.

Anaheim disease, also called the California Vine disease, was of the greatest importance a number of years ago when almost all the vineyards in Southern California died from a mysterious trouble

which received this name. At present vines are occasionally affected with something which might pass for the same disease, but it is difficult or impossible even for the experienced plant pathologist, save, perhaps, one who was familiar with the Anaheim disease at the time of its first and greatest period of prevalence, to say just what is really Anaheim disease and what is one of the various troubles which have received other names. We quote as follows from California Experiment Station Bulletin 197:

Mysterious Dying of Vines

Anaheim Disease

"The vine, like most plants, especially fruit trees, which are cultivated on a large scale, is subject to diseases of more or less intensity whose cause is not thoroughly understood. These diseases are (1) caused by parasitic organisms which have so far escaped detection, or (2) what is usually known as 'physiological.'

"Physiological diseases are presumably due to some unfavorable conditions. For example, *chlorosis*, or the failure of the leaves to develop *chlorophyll* properly, is due to an excess of soluble lime carbonate in the soil, and is intensified by cold, dampness and the susceptibility of the variety.

"The most serious of these two classes of diseases, which affects the vines, is the *Anaheim*, or, as it is sometimes called, the *California Vine Disease*. Notwithstanding that it has been the subject of continuous investigation for over 15 years its cause is still quite obscure. Even the characterization and detection of the disease are so uncertain that vineyards, which after several years of observation by the most experienced investigators have been pronounced infected, have later been declared free. This has led to such a diversity of opinion that while one expert claims that the disease exists in every vineyard in the state, another would have us believe that no such disease exists at all, and that all cases of dying vines can be ascribed to one or other of the recognized vine diseases.

"Neither of these extreme views seems to explain completely the observed facts. While many cases of supposed *Anaheim* have proved to be nothing but *Phylloxera*, root rot, vine hopper, drought, etc., there still remains a large number of unexplained cases.

"In some cases the symptoms are practically identical with those of some of the 'physiological' diseases which affect the vine in Europe. Typical cases of *Rougeot* have been noted in Contra Costa county, of *Brunissure* in San Joaquin, and of *Folletage* in Fresno, Kings, and other counties. In Sonoma county the disease of *Red Leaf*, which has some analogy with *Anaheim*, has been studied by Mr. O. Butler. An account of these diseases may be found in Bulletin 168, entitled 'Observations on Some Vine Diseases in Sonoma County.'

"In a general way, as these troubles are due to soil and climatic conditions which weaken the vine, they are to be combated by cultural methods which tend to invigorate. Shorter pruning, thorough cultivation, irrigation or drainage, and fertilization will in most cases be effective in curing vines which are not too far gone.

"Many cases have been brought to the attention of the station during the last two years, in which vines which were apparently healthy the previous year have failed to bud out in the spring, or budded out weakly and very late. The cause, in most cases, seemed to be some injury to the vines during the growing season of the previous year. This cause was in many cases the attacks of vine hoppers. Black Prince vines growing in Tokay vineyards have very often been killed. This seems to be because the vine hoppers, having a special fondness for this variety, congregate in large numbers on such isolated vines. Whenever the hoppers are sufficiently abundant to cause the dropping of the leaves in summer, the vine fails to ripen its wood properly. Without mature green leaves the buds and canes do not receive the stores of starch which they need for the new growth in spring, and will either grow

poorly the following year or fail to start at all.

"When a new growth of leaves in autumn follows summer defoliation by hoppers, mildew, or other causes, the effect is even worse. The new shoots which start exhaust what food reserves the vine possesses, and the leaves are killed by the early winter frosts before they have been able to return the supplies they have taken from the canes. Similar, but less severe, effects have been observed following a bad attack of mildew.

"This starvation of the canes and buds may be brought about in another way, namely, by the production of too large a crop. It is often possible, by excessively long pruning, to cause a vine to produce an abnormally large crop of grapes. The larger the crop the more material it takes from the vine, and if too large, the vine is unable to support it and at the same time lay up reserve materials in its canes and buds. In consequence, an extra large crop is often followed by weak growth in the spring, and a consequent small crop the following autumn. Vines of heavy bearing varieties may even be killed in this way, by repeated long pruning

"This fact has been long recognized by practical grape growers. Lately, Professor L. Ravaz,* of the National School of Agriculture at Montpellier, France, has advanced the opinion that the death of vines, as a consequence of overbearing, is much commoner than is usually supposed. This overbearing may occur as a consequence of various conditions other than long pruning. Some seasons are peculiarly favorable to heavy crops. Certain diseases and injuries induce temporary heavy bearing. Whatever the cause of abnormally heavy crops, Professor Ravaz believes that they may result in the death of vines. This is the explanation he gives of the death of large numbers of vines in Southern France, Algeria, and other countries, and he ascribes our so-called *Anaheim* disease to the same cause.

* "Influence de la surproduction sur la Vegetation de la Vigne," by L. Ravaz, Coulet et fils, Montpellier, 1906

"This is substantially the explanation given of the dying of vines in Santa Clara, in Bulletin 134, which was published before the region was declared infested by *Anaheim* disease. Whether this explanation is sufficient is still doubtful, though it is rendered probable by the fact that healthy young vineyards are now growing in Santa Clara, on the same soil where vines have been killed by *Anaheim* disease."

GRAPE PESTS

Achemon Sphinx or Hawk Moth

Pholus achemon Drury
Family *Sphingidae*
Philampelus achemon Drury

General Appearance

The adult moth is of a brownish-gray color with light and dark variegations and well defined dark brown spots. The hind wings are rich pink with brown border and dark spots. The body is reddish gray with two deep brown triangular spots on the thorax. The expanded wings measure easily four inches across. The larva or caterpillar is first green, changing to reddish-brown as it grows older. The dorsum is brown with from six to eight whitish, oblique bars along the sides. The pupae are rich brown.

Life History

The eggs are green and round. The winters are passed in the chrysalis stage, the adults emerging about the time the foliage appears upon the grapevines. The eggs are glued to the leaves and hatch in a comparatively short time into small green caterpillars. These are ravenous feeders, grow very rapidly and do much damage to the foliage of the vines. In about one month they are full grown and go into the ground to pass the winter in the pupal stage.

Food Plants

The caterpillars feed upon wild and cultivated grapevines and the Virginia creeper.

E. O. Essig

Apple Leaf Hopper. See *Apple Pests.*
Black Scale. See *Apricot Pests.*
Blister Mite. See *Pear Pests.*

California Grape Root Worm

**Adoxus obscurus* Linn.
Family *Chrysomelidae*

General Appearance

The adult beetles are about three-sixteenths of an inch long, jet black in color and partially covered with fine whitish hairs giving them a grayish cast. The prothorax is noticeably narrower than the rest of the body. The antennae and legs are usually black, but are sometimes brown. The eggs are elongated, yellowish-white and one-twenty-fifth of an inch long. The full-grown larvae are white with brown heads and about one-fourth of an inch long. The heads are usually curved in towards the ventral surface of the body. The pupae are white and about the same size as the fully developed larvae.

Life History

The eggs are laid early in the spring, usually in clusters of from one to two dozen, in cracks or crevices beneath the bark upon the trunk of the vines, anywhere within six inches above the surface of the ground. They hatch in from eight to ten days and the young larvae immediately seek the roots of the vines underneath the ground and attack first the small rootlets which are often en-

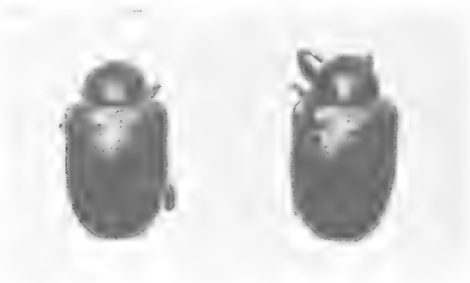


Fig. 1. *Adoxus obscurus* Linn. (Original.)

tirely destroyed. The large roots are also attacked and large patches of bark removed. They continue to feed underground until fall, when they are full grown and remain dormant during the winter, transforming into delicate pupae in the spring and after about two weeks emerge as adult insects. The larvae and pupae are usually found within a radius of fifteen inches from the trunks and at a depth from two feet to less. The adults appear about May to begin egg-laying and disappear in June.

Food Plants

The larval forms work upon the roots and the adults work upon the foliage and fruit of practically all the commercial varieties of grapes.

Control

Thorough cultivation, close to the bases of the vines, will kill many of the larvae and pupae. The adults may be kept in check by repeated applications of arsenical sprays. Jarring them into receptacles, containing oil, is also recommended.

E. O. Essig

Cottony Cushion or Fluted Scale

Icerya purchasi Mask.

General Appearance

The adults are distinguished by large, white fluted cottony masses with distinct red or yellow bodies, varying from one-fourth to one-half inch in length and three-fourths as wide. There are two varieties, as follows: *Icerya purchasi* var. *crawii* Ckll., of which the body proper is yellow or light brown, and *Icerya purchasi* var. *maskelli* Ckll., the body of which is very dark brown or almost black. The eggs and young are bright cardinal red.

Life History

The large cottony masses are the egg-sacs of the females, and may contain from four hundred to a thousand eggs. The males soon after hatching secrete themselves in a white cocoon for transformation, which requires nearly one month. The females are matured in from three to four months. There are several broods during the summer, when the scale increases enormously and may do great damage.

Food Plants

All citrus trees, pomegranate, quince, apple, peach, apricot, fig, walnut, locust, willow, pepper, grape, rose, castor bean, spearmint, rose geranium, purslane, ambrosia, nettle, sweet-gum, white oak, flow-

* The light-colored form has the wing covers, tibiae and basal half of the antennae brown, while the rest of the body is black. This species is known as *Adoxus vitis* Fourc., and the life history and habits are almost identical with those of *Adoxus obscurus* Linn.

ering almond, pecan, potato, nightshade, Bermuda grass.

Control

Artificial control by sprays and fumigation are never practiced because of the efficiency of natural enemies. This is the one case where nature controls perfectly a serious pest.

Predaceous Enemies

The common Vedalia *(Novius cardinalis)* and the Koebele's ladybird *(Novius koebelei)* are the ladybird beetles which keep the cottony cushion scale in complete subjection. In many localities in California the former is the most efficient, but in some places, and especially in Ventura county, the writer found the latter doing most of the control work.

While these ladybirds are usually present in limited numbers in most sections, yet at times they completely disappear and the cottony cushion scale increases so as to cause considerable damage before the beetles can again be established. It is always well to keep a close watch of this pest, and if it appears without being accompanied by the larvae of the Vedalias, adults of the latter should be obtained and liberated as soon as possible.

True Parasites

There are two true parasites which also prey upon this coccid: the hymenopterous enemy, *Ophelosia crawfordi*, and the dipterous parasite, *Cryptochaetum (Lestophonus) iceryae* Will. The latter is often responsible for as much effective work as are the Vedalias, though this fact is not generally known.

E. O. Essig

Cottony Maple Scale. See *Apple Pests*.
Cutworms. See *Index*.

Erinose*

Erinose is a disease of the vine characterized by swellings on the upper surface of the leaves, and corresponding depressions on the lower surface. These swellings, when numerous, cause considerable deformation of the leaves, but not the change of color to yellow or brown which is characteristic of most fungous diseases. Even very badly affected leaves retain almost their normal green color on the upper surface until late in the season. The depressions on the under side are coated with a thick felt-like covering, which, at first pure white, gradually turns rusty and finally becomes dark brown. Generally, the swellings and corresponding depressions are isolated and few in number on the affected leaves, but in severe cases they are numerous enough to become confluent and the whole lower surface is then completely hidden by the felt-like covering. Occasionally, indeed, the felt-like material extends to the upper surface in narrow strips bordering the veins, and may even be found on the petioles and flower clusters.

Many have the impression that they are attacked by a fungus, and, in fact, the coating has a strong superficial resemblance to some fungous growths. A microscopic examination shows, however, that it consists of a mass of hypertrophied hairs or abnormal outgrowths of the epidermal cells of the leaf. They are larger, more abundant, and more persistent than the normal leaf-hairs of the leaf, and differ also in being often branched and usually unicellular. This abnormal growth, in common with similar growths found on other plants, is called an *erineum*, from a Greek word meaning woolly. This is the derivation of the word erinose, which means woolly disease—a very appropriate name. The erinea of leaves were formerly supposed to be of fungous origin, but are now known to be due to the attacks of minute mites. The feeding of these mites exerts a stimulating effect upon the epidermal cells of the leaf, which causes them to grow out into the abnormal hair-like processes already described. The mite causing erinose of the vine is known as *Eriophyes vitis*, and is related to the mites causing a similar disease of the walnut and the leaf blister of the pear, both of which are very common.

The *Eriophyes vitis* is not a true insect, but a mite or acarid belonging to

* Revised from Bulletin No. 136, by F. T. Bioletti and E. H. Twight, by H. J. Quayle, California Experiment Station.

the class of Arachnida to which belong also spiders, scorpions, ticks, and our common red spider so destructive to fruit trees. These mites are extremely minute, and only a practiced eye can perceive them among the tangled mass of erineum on the leaf, by the aid of an ordinary hand magnifier, and then only with great difficulty.

Amount of Injury

Erinose was formerly considered to be a very serious disease of the vine, owing to the fact that its effects were confused with those of the powdery mildew. It is only in very exceptional cases that it is, alone, capable of doing serious injury to the vine or its crop. All varieties of vines are not equally attacked. According to Ravaz, certain American species such as Berlandieri, Mustang, Cinerea, Cordifolia, and Scuppernong are immune. All varieties of Vinifera are susceptible, but not equally. Of varieties cultivated in California, Sauvignon, Sirah, Marsanne, and Gamay Teinturier are said by Ravaz to be little subject to attack; while Aramon, Cinsaut, and Frontignan (Small Muscatel) are very susceptible. The worst cases so far observed in California have been on Flame Tokay and Mission, but it has been found also on other varieties, among them Zinfandel and Muscat.

Methods of Treatment

Since sulphuring the vines for the treatment of odium has become general in France, there has been little trouble with erinose. The mite seems as sensitive to the fumes of sulphur as the red spider, and several sulphurings during the late spring and early summer are recommended for the control of the mite. The vineyards badly affected are usually those in which little or no sulphuring has been done, or those where the growth of foliage has been so luxuriant as to prevent the evaporation of the sulphur by the sun. In the latter cases the vines are so strong that they practically receive no harm from the disease. Tests made on Tokay vines indicate that the erinose can be easily and readily controlled at any stage by sulphuring. In severe cases a winter treatment of the vine stumps is practiced in France. This treatment consists in pouring about one quart of boiling water over the stump. For very large stumps a somewhat greater amount of water is used, and for smaller vines a proportionate amount. This method is said to be very efficacious, and with the portable boiler constructed for the purpose two men can treat from fifteen hundred to two thousand vines per day. Cuttings taken from affected vines for the purpose of rooting or grafting may be thoroughly disinfected by placing them in hot water (122 degrees Fahrenheit) for ten minutes. If this is done carefully all the mites and their eggs will be destroyed without injury to the cuttings.

EUROPEAN FRUIT SCALE. See *Apple Pests*.

FROSTED SCALE. See *Prune Pests*.

Grape Berry Moth

Polychrosis viteana Clem.

The larva of the grape berry moth infests the berry or fruit of the grape. The first generation attacks and webs together the grape clusters even before the blossoms open or soon after the grapes are set. Later-appearing larvae bore into the green or ripening fruit and produce a purplish spot much resembling in appearance the injury due to the black-rot fungus, with which it is frequently confused. Within the fruit the larvae feed on the pulp and seeds, passing from one grape to another, and several of these discolored and shriveling berries will often be found more or less webbed together with numerous particles of larval excrement, and sticky with exuding grape juice. Other insects attack the fruit of the grape, such as the grape-seed insect *(Isosoma vitis* Saunders), whose larvae feed on the seeds, causing the berries to shrivel late in the summer, and the grape curculio *(Craponius inaequalis* Say), whose injury closely resembles that of the grape berry moth. But the principal cause of wormy grapes throughout the country is the larva of the species under consideration. Until recently it was thought that our grape berry moth was introduced from Europe many years ago, but this has been disproven. It is very probable that the grape is the sole

food of this species. This important fact greatly simplifies the question of its control, for if the species had other food plants vineyards would be reinfested from outside sources despite thorough treatments.

Distribution and Destructiveness

The American grape berry moth occurs from Canada south to the Gulf and westward to California. It is very generally distributed over this area, and wherever the grape is grown it is more than likely to be found.

Description and Life History

The grape berry moth is small, the wings expanding not quite one-half inch. The general color is purplish brown. Moths appear in the spring from hibernating pupae, beginning about the time the shoots of the grape are pushing out, and continuing to emerge for some weeks. The earlier-appearing individuals deposit their eggs on the blossom clusters, while those coming out after the blossoms are shed oviposit on the clusters of young grapes.

The minute scale-like eggs of the first brood of moths are difficult to find, as at this time they are relatively scarce, but may be readily detected during summer as a glistening or whitish spot on the surface of the berries. The larvae of the first generation feed upon the blossoms and small berries, webbing them together more or less and producing a more or less ragged bunch of grapes, or the cluster may be almost entirely destroyed. Moths of the second and later generations deposit their eggs on the developing grape berries, and the resulting larvae bore into these, feeding on the pulp and seeds, the entrance point of the berry being marked by a purplish spot, which renders their detection quite easy. By this time the insects will have increased greatly in numbers, and the larvae will be attacking almost exclusively the berries of the grape, for which reason their work is much more conspicuous. Second-brood larvae infest the grape during July and August, the later-appearing individuals probably not developing to moths but hibernating in the pupal condition. Many of the earlier-appearing insects of this brood appear to complete their life cycle, and moths develop, giving rise to a third generation of larvae.

Treatment

Poisons

The use of arsenical poisons against the first brood of the grape berry moth was recommended by Mr. Marlatt, of the Bureau of Entomology, in 1895.* Since this time the recommendation has been amply justified in the experience of numerous vineyardists, who, in connection with the fight against the grape root worm, found that their early sprayings for this pest were also controlling the grape berry moth. The first treatment should be made just before the blossoms are ready to open, and the second just after the blossoms have fallen. A third treatment in a week or ten days is also advisable in badly infested vineyards. In all these treatments special care should be exercised to force the spray well through the clusters of blossoms and young fruit. It will be noted that the second and third treatments for the grape berry moth will coincide with the first and second treatments for the grape root worm, and the arsenicals recommended for that insect will be equally satisfactory for the grape berry moth.

A. L. QUAINTANCE.
Farmers' Bulletin 284.

Grape Blossom Midge

Contarinia johnsoni Sling.

Present in the Erie and Chautauqua grape sections in New York.

It is a tiny fly, almost microscopic, and yet seems capable of destroying a whole crop. They emerge from the soil about the time the buds of the early flowering grapes are ready to open. The eggs are laid in the opening flower bud and the larvae so injure the flower that no berry sets. Their presence is indicated by the swelling and reddening of the bud. By the last week in June the larvae have entered the ground, where they remain in pupation until the following spring.

* Yearbook, United States Department of Agriculture, 1895, p. 404.

One or two early applications of a nicotine spray is the only remedy suggested.

Literature

New York (Geneva) Bulletin 331.

Grape Cane Borer

Amphicerus bicaudatus Say.

The young shoots of the grape during the spring months in some districts will often be observed to suddenly break off or droop and die, and if examination be made a small hole will be found just above the base of the withered shoot, with a burrow leading from it a short distance into the main stem. Within the burrow will be found the culprit in the form of a peculiar cylindrical brown beetle about half an inch long. This beetle has long been known as the apple twig borer, from its habit of boring into the smaller branches of the apple in the manner described for the grape. It also sometimes similarly attacks pear, peach, plum, forest and shade trees and ornamental shrubs. To the grape, however, it is especially destructive, and the name "grape cane borer" is now given to it as more appropriate. Much complaint of this beetle is always received during the winter and early spring. Frequently all the new growth is killed, and in some cases vines have been entirely destroyed. It is extremely common in the states bordering the Mississippi, from Iowa to Arkansas, and also in Texas, often becoming, throughout this region, the most important insect enemy of the vine. It also occurs eastward to the coast, but rarely causes much damage in its eastern range.

It breeds in dying wood, such as large prunings, diseased canes, and also in dying or drying wood of most shade and fruit trees. It has been found by the writer breeding very abundantly in roots of uprooted maples and in diseased tamarisk stems. In old, dry wood it will not breed, so far as is known, nor in vigorous live growth, but seems to need the dying and partially drying conditions mentioned. The insect has but one brood yearly. The beetles mature for the most part in fall, and generally remain in their larval burrows until the following spring. A few may leave the burrows in the fall and construct others in the twigs of apple or other plants in which to hibernate. In the spring, however, they begin their destructive work early, burrowing into the axils of the grape and occasionally also into other plants. This is undoubtedly partly for food, but seems largely malicious, for it certainly has nothing to do with egg-laying, although it may have some connection with the marital relation. The eggs are laid chiefly in May, or as early as March or April in its southern range, and the larvae develop during summer, transforming to pupae and beetles in the fall.

On the Pacific coast a closely allied but somewhat larger species (*Amphicerus punctipennis* Lec.) breeds in grape canes and other plants, and probably has similar burrowing habits in the adult stage.

Remedies

It will be apparent at once that to limit the work of this insect it will be necessary to promptly destroy all wood in which it will breed. This means the careful removal and burning of all diseased wood and prunings at least by midsummer, thus destroying the material in which the larvae are probably undergoing their development. If precautions of this sort are neglected and the beetle appears in the vineyard in spring, the only recourse is to cut out by hand every affected part and destroy the beetles. On warm days they may sometimes be collected in numbers while running about the vines.

C. L. Marlatt,
Washington, D. C.

Grape Curculio

Craponius inaequalis Say

The grape curculio is one of the "snout beetles" belonging in the same family as the so-called plum curculio. The parent beetle deposits her eggs in little cavities which she eats into the grapes, and the resulting larvae feed upon the pulp and seeds, producing an injury quite similar to that done by the grape berry moth. The beetles cut small, rather characteristic holes in the grape leaves when feeding, and the berries often show

a purplish coloration at the point punctured in egg-laying. If infested berries be examined it will be readily possible to distinguish between the grape curculio and the grape berry moth, since the grubs of the former are whitish and quite destitute of legs, whereas the larvae of the berry moth have well developed legs, are greenish in color, quite agile, and likely to escape quickly upon being disturbed.

Distribution and Destructiveness

The grape curculio is a native species, feeding originally on the wild grape, as it does at the present time. It is distributed well over the United States east of the Rocky mountains.

Life History and Habits

The insect passes the winter in the adult or beetle stage, hiding under trash in and near vineyards, especially bordering woods. About the time in the spring that the grape is in bloom the beetles come from their hibernation quarters and for the first few days or a week are quite sluggish, but gradually become more active, feeding on the foliage of the grape until the berries are about one-fourth grown or of sufficient size to be suitable for receiving the eggs. This habit of feeding on the exposed portions of the vines some three or four weeks before egg-laying permits of their ready destruction by arsenical poisons. Late in June, in the latitude of West Virginia, the females begin depositing eggs in the berries, excavating a cavity in which a single egg is placed. About four to six days, varying with the temperature, are required for the eggs to hatch, and the resulting larva burrows through the pulp, reaching the seed in three or four days, which is penetrated and the contents devoured. In 12 to 15 days the larva has become full grown and leaves the berry by eating a hole to the outside, falls to the ground and at once seeks a suitable place for pupation, as under stones, lumps of earth, or just below the surface of the soil. Here an earthen cell is made and the larva transforms to the pupa, the adult beetle emerging in the course of 18 or 19 days, at first blackish in color with gray hairs, but soon becoming the normal brown color.

The life cycle from egg to adult, as stated by Brooks for a large series of individuals, requires about 35 days. The new generation of beetles feed upon the foliage until fall, when they go into hibernation, appearing the following spring, as stated.

Treatment

Poisoning

The beetles feed freely upon the foliage of the grape in the spring for several weeks before egg-laying begins and continue feeding in the fall after egg-laying ceases along with beetles of the new generation, and it is thus an easy matter to bring about their destruction by arsenical sprays. The treatments advised for the grape berry moth and root worm, with perhaps an additional treatment two or three weeks later, will practically control the insect.

A. L. QUAINTANCE,
Farmers' Bulletin 284.

Grape Leaf Folder

Desmia funeralis Huber

This insect occurs in considerable numbers in some sections every year, but the total injury is not usually very great.

They may be easily detected in a vineyard by the characteristic rolling of the leaves. One edge is rolled up rather tightly to about half way across the leaf, making a tube less than the diameter of a lead pencil, in which the larva lives. The leaf is always rolled on the under side. The insects feed by eating off the free edge of the leaf in the interior of the roll, so that they are always protected by the outer layers of the rolled portion. The insect hibernates as a chrysalis, appearing and laying eggs upon the vine in the spring. The larvae of the first brood appear about the first of June and by the twentieth of June they change to pupae. The larva is a greenish-white caterpillar, about an inch long when full grown. They wriggle out of their nests very vigorously when disturbed and drop to the ground. There are two broods in a season.

This insect occurs, apparently, through-

out the United States. It is very common in the Eastern and Middle Western states, but there is a striking difference in habits between the insect there and what is considered the same species in California. In the East, the leaf is simply folded over on the upper surface and the edges sewed down by strands of silk. There the larva feeds by eating off the upper surface of the leaf, thus skeletonizing it. In California the leaf is very disstinctly rolled, and instead of eating off the upper surface it feeds on the free edge.

The moth is nearly an inch across the expanded wings, and is black with white markings. There are two white spots on each wing, those on the posterior wings being larger, and in some specimens fusing into a single large spot. There are also two white bands across the abdomen, one about the center and one near the tip. The wings are also bordered with a fringe of white, and the tarsi and apical half of the antennae are white.

Control Measure

The only control measure which is likely to prove effective is to spray with an arsenical before the rolling of the leaf is commenced, so that they may be obliged to eat the poison, even though they are within the rolled portion. If they are not too abundant, hand picking or simply crushing the folded portion of the leaves will be the most practical.

H. J. Quayle,
California Experiment Station Bulletin 192.

Grapevine Hoplia

**Hoplia callipyge* Lec.
Family *Scarabaeidae*

General Appearance

The adult beetles vary from five-sixteenths to three-eighths of an inch in length. The head and thorax are dark brown, being the darkest portions of the entire body. They are often covered with fine golden pubescence, giving them a mottled appearance. The wing covers or elytra are brown—nearly as dark as the

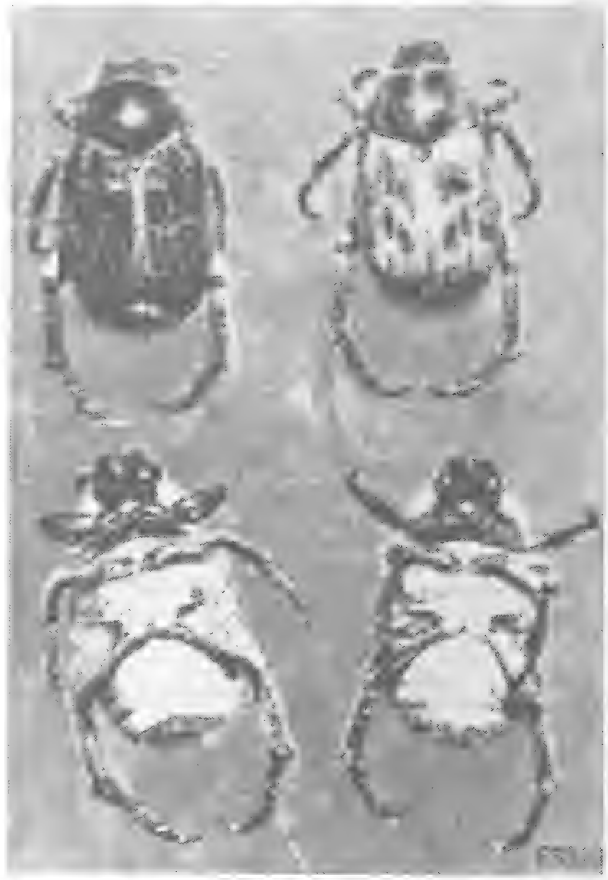


Fig. 1. The Grapevine Hoplia (*Hoplia callipyge* Lec.), Showing Dorsal and Ventral Aspects.

head and thorax or considerably lighter in some species. They are also pubescent and often appear white mottled, due to the fact that the fine hair or powder is removed in certain places. The entire ventral surface, excepting the head, is beautifully iridescent silvery green, as are also the blunt posterior end of the abdomen, the coxae and femora of the legs. The rest of the legs and antennae are brown. The larvae are white grubs and live in the soil.

Life History

The life history of this beetle has not been worked out, but it probably resembles that of the other chafers. The glossy white eggs are laid in old pastures. The grubs feed upon the plant roots and grow very slowly, requiring from one to two years to become full grown. They remain in the larval or pupal stage throughout the winter and emerge as adult beetles early in the spring and attack many kinds of vegetation.

Food Plants

The usual food appears to be the young buds and older foliage of rose bushes,

* Another species, *Hoplia sackenii* Lec., also occurs in the central and southern part of the state and works upon the grapevine.

Hoplia pubicollis Lec. is lighter in color than *H. callipyge* Lec. and occurs in the Sierra foothills, but apparently is not a pest.

which often suffer greatly from the attacks. As early as 1893 it has been known to do considerable damage to the buds and leaves of grape vines in California. Occasionally large areas of vineyards are completely stripped. It also feeds upon greasewood.

Control

The larval and pupal forms are found in the soil, especially in unplowed pastures and places around fences, ditches, etc. Thorough cultivation of these places will not only kill the young then present, but will keep the adults from laying eggs there. Poison sprays applied when the beetles begin to appear in considerable numbers and repeated every week will aid materially in saving the buds and foliage. Jarring the beetles into a suitable receptacle containing oil may also prove effective, especially if only small areas are badly infested.

E. O. Essig

Grape Leaf Hopper

Typhlocyba comes Say.

General Appearance

The adult insects are very small, scarcely more than one-eighth of an inch long. During the summer they appear light yellow with the wing covers or elytra mottled with red. As the season advances the color becomes darker, and in winter it is dark red; this change is due to the increasing brightness of the red markings, which are very faint during the summer months. The young appear very much like the adults, excepting that their wings are not fully developed and there are less of the red markings.

Life History

The eggs are bean-shaped and so small as to be almost microscopic. They are inserted just beneath the epidermis on the underside of the grape leaves and hatch in from 15 to 20 days. The young nymphs begin at once to feed upon the first-appearing foliage by extracting the juices from the leaves with the sharp beaks. There are two broods a year—winter and summer. The adults of the former hibernate and begin feeding upon the first foliage in the spring. During May they begin egg-laying, which gives rise to the summer brood. This brood grows very rapidly and lays eggs within a few weeks, dying off in the fall. Their eggs give rise to the coming winter brood. Thus the destruction may begin in May and end only when all of the leaves have fallen.

Food Plants

The principal and practically the only food during the summer months is the foliage of the grape, but during the winter many other plants are attacked, such as grasses, clover, alfalfa, mustard, ragweed and filaree.

Control

A spray containing .02 of one per cent nicotine has proven to be the most effective contact insecticide for this pest This must be applied when the nymphs begin to appear about the first of June, and great care taken to drench the under sides of the leaves. High pressure is necessary for good work.

Screen cages have been used very successfully in many localities in the state. Plowing and cultivating close to the vines and practicing clean culture aid in reducing the numbers.

Natural Enemies

So far no internal parasites of this pest are known. The larvae of the California green lacewing *Chrysopa californica* Coq. devour the young nymphs. Ladybird beetles also prey upon the young, but are of little consequence in the matter of control.

Grape Phylloxera

**Phylloxera vastatrix* Planchon

General Appearance

The presence of this pest is usually manifested by its work, which consists in the formation of rough wart-like galls upon the leaves and small knots upon the roots. The lice producing the galls are very small and orange-colored. White eggs and the young are also to be found within the galls, which are seldom found in California. The root lice are about one-twenty-fifth of an inch long and

* According to priority rules the scientific name of this species should be *Peritymbia vitifoliae* (Fitch).

greenish-yellow in summer and a little darker in winter.

Life History

During the months of July and August some of the eggs laid by the females of the root forms hatch into individuals which acquire wings. These seek the foliage of the vines and lay large eggs which produce true females and small eggs which produce males. These mate and each female lays a single winter egg upon the bark of the two-year-old wood. In the spring this egg hatches into a root form (or gall-making form) which gives rise to the root forms in other stages. These lay eggs which give rise to the many summer generations of devastating insects. In California the latter hibernate in the soil and may continue for at least four years without reverting to the sexual forms.

Food Plants

This insect feeds upon practically all varieties of grape vines, but is most damaging to the European varieties. Many cultivated varieties and hybrids as well as wild species are slightly attacked, but not so as to greatly impair their growth. These latter are known as resistant vines and are important factors in the selection of roots for vines set out in *Phylloxera*-infested districts. While the leaves are damaged to some degree, the main source of injury is due to the attacks upon the young and vigorous roots, which are completely destroyed. The roots of the so-called "resistant stock" do not materially suffer from such attacks.

Control

By far the most important method of control is the use of resistant root stocks upon which are grafted the desired varieties. Of course care must be exercised in selecting stock for the various varieties and expert advice obtained before making extensive selections or plantings.

Direct remedies for infestations are unsatisfactory. Flooding the vineyards if the water can be held for a month will almost exterminate the pest, if done in the winter, but such a method is impracticable in most of the grape-growing sections of the state.

Carbon bisulfid is an efficient remedy in loose sandy soil, but in such places the pest is usually less abundant.

Natural Enemies

In the Eastern states many predaceous insects feed upon the gall form, but as this stage does not occur to any extent in California there are practically no results from these or other natural checks.

E. O. Essig

Grape Root Worm, or Grape Vine Fidia. *Fidia viticida* Walsh. See *California Grape Root Worm.*

Grape Scale

Aspidiotus (Diaspidiotus) uvae Comst.

This insect has a wide distribution over the eastern part of the United States and has proven of considerable importance.

Infested vines have the appearance of being covered with a "dingy white scurf." The habits of this scale are somewhat similar to those of the San Jose scale, but the grape seems to be its only host of economic importance.

The female gives birth to living young, 35 to 50 during May and June. These are active for about two days when they settle down to a sedentary life under cover of a waxy shield which they excrete.

Spray with lime-sulphur once, about one week after the first appearance in the spring. Later applications are necessary sometimes.

Reference

Bureau of Entomology Bulletin 97, Pt. VII.

Grape Seed Chalcis

Evoxystoma vitis

In the latter part of the summer grapes will sometimes shrivel and dry up. Examination of the seeds will find some of them missing and others enlarged. The swollen seeds may be found to contain a small white grub. This is the grub of the grape seed chalcis, which emerges, a wasp-like fly, some time the following summer.

According to Gossard it prefers the wild grapes.

Destruction of affected berries is all that is needed.

Reference

Ohio Experiment Station Bulletin 233.

GRASSHOPPERS

Valley Grasshopper

Edaleonotus enigma Scudd.

General Appearance

One of the smaller species, the adults being about one-fourth of an inch long. The general color is rich amber with reddish hue around the eyes. The dorsum and carinae of the thorax are dark. The tegmina are mottled with black and dusky spots. The antennae and first two pairs of legs are concolorous with the body, while the femora of the hind legs are richly marked with black and the tibiae are pale blue. The young are nearly of the same general color, with the dark markings less pronounced.

Life History

The holes in which the eggs are laid are usually drilled in hard or compact soil. The eggs are laid regularly and horizontally and cemented together, as well as being surrounded with a liquid cement which renders the mass waterproof. The young hatch the following spring as soon as it becomes warm, and they begin to reach maturity early in June. Pairing begins soon after and eggs are deposited from August to October. There are two forms of the adults, characterized by long and short wings. The species is very prolific and does much damage. It is only occasionally migratory.

Fig. 1. The Valley Grasshopper (*Edaleonotus enigma* Scudd).

Distribution

Throughout the lower San Joaquin valley, especially in the Turlock region.

Food Plants

All forms of vegetation, including the foliage of orchards and vineyards, uncultivated field crops, such as alfalfa, clover, grain, etc., and cultivated crops, such as vegetables, corn, potatoes, etc., are attacked.

Differential Grasshopper

Melanoplus differentialis Thomas

General Appearance

This is one of the larger hoppers, averaging one and five-eighths inches from front to the tip of the tegmina or wing covers. A very beautifully colored insect when fully matured. The head, thorax, abdomen and first two pairs of legs are amber or rich brown, the sutures being dark. The wing covers are brownish gray—the true wings being transparent. The hind femora are yellow with black cross lines, while the tibiae and tarsi are bright red, the former with black spots near the outer base. The spines and claws are black. The antennae are reddish with dusky tips. The nymphs are green.

Life History

Egg-laying begins about the middle of the summer. The holes for the eggs are drilled into the soil in bare and vacant places, especially in alfalfa fields. From 60 to 80 eggs are laid by each female. They are protected from winter rains and freezes by an excretion of the female which makes the capsule containing them waterproof. They begin to hatch in the warmer spring months, appearing early in June, and keep up their destructive work until August. The young green hoppers, as they mature, acquire wings and assume a yellowish tint, thus causing the belief that there are two distinct species. The largest brood appears early in the summer, and the greatest amount of damage is done by the first of August.

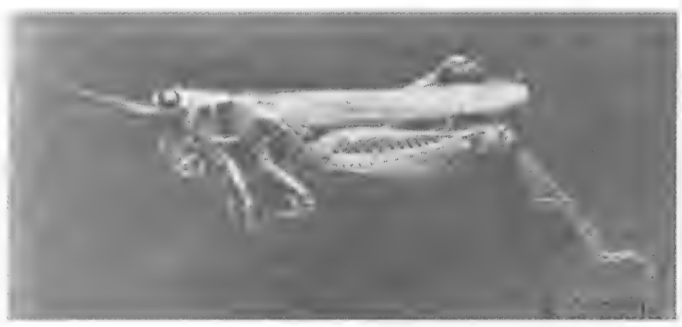


Fig. 1. The Differential Grasshopper (*Melanoplus differentialis* Thomas).

Distribution

Especially abundant in the San Joaquin valley, though the species has a somewhat wider range throughout the state. Outbreaks have been recorded at Newman and Los Banos in past years. This year it was especially abundant in Madera county.

Food Plants

Practically all kinds of green vegetation, including most of the forage and truck crops. Especially destructive to alfalfa. Orchard trees and vineyards are also attacked, some trees and vines being completely defoliated and many killed.

Hopper Dozer

The use of the hopper dozer has become an important factor in the control of grasshoppers, especially in grain and hay fields, in pastures and even in cultivated crops. The hopper dozer is constructed as shown in Fig. 2. The back and sides are made of thin sheet iron or cloth and the pan at the bottom constructed to hold about two inches of kerosene. These dozers may be made any length but a two-horse size is the most practicable. They are simply drawn across the fields and capture the hoppers as the latter endeavor to escape their approach.

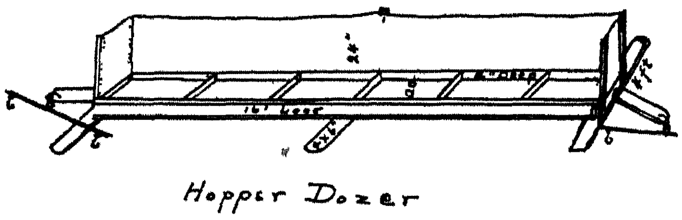


Fig 2. Plan of a Very Good Hopper Dozer. (After Urbahns)

Though the hoppers may escape from the kerosene bath, they are doomed.

The best time of operation is on warm days if possible, early in the season before the hoppers have acquired wings.

A brief description of some of the most common and destructive California species follows.

E. O. Essig

Greedy Scale. See *Apple Pests*.

Nematode Root Gall

These tiny creatures belonging to the order *vermes* cause irritation of the roots of numerous plants including the grape. On this plant they give rise to galls or swellings somewhat similar to those produced by the *phylloxera*.

*Quayle says that "no satisfactory remedy has yet been found for controlling parasitic nematodes. In greenhouses the usual procedure is to sterilize the soil, but this, obviously, is not applicable to a vineyard. However, if the soil is known to be infested, disinfection is sometimes practiced before planting out young vines. This is done by an application of carbon bisulfid to the soil. Trap plants have also been used, these being annuals that are pulled up before the nematodes escape. In time it may be found that resistant stock is the solution of the problem. In the bulletin already referred to it is stated that the Isabella is slightly resistant, while *Vitis riparia* has shown no nodules after the first year This fact is interesting as a suggestion that both *phylloxera* and *nematodes* may be controlled by the same resistant."

Pear Thrips. See *Pear Pests*.

Red or Orange Scale

Chrysomphalus aurantii Mask.

General Appearance

Distinctly circular and flat, the female scales varying from one-sixteenth to one-eighth of an inch in diameter. The scale or shell is transparent, allowing the red female body, which gives it a distinctly red color, to show through. The male scales are elongated, very much smaller and gray or dark brown in color.

Life History

The young are born alive in great numbers. They are usually produced during the warm summer months from June to September, but in the milder sections may continue to appear much longer. Like other coccids the males are winged and so small as to be scarcely observed. The females settle on the trunks, limbs, foliage and fruit, and cause great damage. Trees may be entirely killed by their attacks. It is one of the most serious pests known to citrus fruit culture.

* California Experiment Station Bulletin 192.

Distribution

Throughout the Southern citrus belt in California.

Food Plants

All citrus trees, camphor, fig, olive, rose, pear, plum, apple, quince, willow, oak, grape, acacia, tea plant, wattle, sago palm, nightshade, English walnut, eucalyptus, passion vine, date palm, California fan palm, goldenrod, lignum-vitae, fuschia, box elder, agave, cocoanut and pistacia.

Control

Spraying is efficacious on deciduous fruits with lime-sulphur (1-9), caustic soda distillate water mechanical mixture or distillate emulsion.

Natural Enemies

Various species of the ladybird beetles, green and brown lacewings and several internal parasites.

E. O. Essig

Rose Chafer

Macrodactylus subspinosus Fabr.

With the blooming of the grape, an awkward, long-legged, light-brown beetle about one-third of an inch in length frequently appears in enormous swarms, at first devouring the blossoms, then the leaves, reducing them frequently to mere skeletons, and later attacking the young fruit. By the end of July these unwelcome visitors disappear as suddenly as they come.

Though now distinctively a grape pest, it was first known as an enemy of the rose, whence its name, "rose-bug," or rose chafer. It attacks also the blossoms of all other fruit trees and of many ornamental trees and shrubs, and, in fact, in periods of great abundance, stops at nothing—garden vegetables, grasses, cereals, or any green thing. At such times plants appear a living mass of sprawling beetles clustering on every leaf, blossom, or fruit.

The rose chafer occurs from Canada southward to Virginia and Tennessee and westward to Colorado, but is particularly destructive in the eastern and central portions of its range, notably in New Jersey, Delaware, and to a less extent in New England and the Central states.

It passes its early stages in grass or meadow land, especially if sandy, the larvae feeding on the roots of grasses a few inches below the surface of the ground like the common white grub, which they closely resemble except in size. The eggs are laid in the ground in June and July, and the larvae become full grown by autumn and transform to pupae the following spring, from two to four weeks prior to the emergence of the beetles.

Remedies

The rose chafer is a most difficult insect to control or destroy, and the enormous swarms in which it sometimes appears make the killing of a few thousands or even millions of little practical value.

Experiments conducted by the Bureau of Plant Industry during the season of 1911 indicate that a very thorough application of arsenate of lead when the beetles first appear, just before the blossoms open, will make a profitable crop possible even in areas where the pest appears in great numbers.

References

United States Department of Agriculture Farmers' Bulletin 70.

Bureau of Plant Industry Bulletin 97.

Rose Snout Beetle. See *Rose Pests* under *Floriculture*.

"Stink Bugs"

There are several species varying in color and size. Two of these, the green stink bug and the bound tree bug, reach a half inch in length. They are green with a margin of red or yellow.

They puncture the berries, leaving a nauseous odor.

Hand picking is all that is necessary.

Reference

Ohio Experiment Station Bulletin 233.

Small Steel-Blue Grapevine Flea Beetle

Haltica carinata Germ.

Family *Chrysomelidae*

General Appearance

The adult beetles are less than one-fourth of an inch long, metallic bluish or purplish in color with antennae and legs black. The last ventral segment of the male has a deep elongated depression.

Life History

The adult beetles emerge from hibernating quarters in the spring and deposit their eggs upon the vines. These hatch very soon and the young grubs begin to feed upon the foliage, completely skeletonizing the leaves. When full-grown they drop to the ground and spin a coccoon in the soil in which to pupate. The adult beetles are very active, jumping quickly when disturbed. They also fly freely.

Food Plants

All stages of the pest are very destructive to the young and tender foliage of the grapevine—though they also attack various vegetables and elms.

Control

Same as for the grape root worms *(Adoxus obscurus)*. Poisoned sprays are especially recommended for the flea beetle.

E. O. Essig

White-Lined Sphinx. See *Cantaloup Pests*.

White Peach Scale. See *Peach Pests*.

Wire Worms
Elatridae

The larvae of the click beetles. The fact that they work in the soil makes control uncertain and difficult. Salty fertilizers, such as *Kainit* or nitrate of soda have been used with good effect as repellants to wire worms. Clean cultivation and the use of poisoned baits, such as green alfalfa treated with strychnine and placed under boards or buried in the ground are effective; poisoned slices of potatoes, carrots or other vegetables are excellent baits.

E. O. Essig

Miscellaneous Insects

Quite a large number of insects which make the vines one of their food plants but never attaining any great importance, may be kept in subjection by practicing clean culture and cleaning the vineyard of all refuse and burning it as well as keeping down weeds and rubbish along fences and lanes.

Grape, Profits From. See *Alabama*.

Green Apple Aphis. See article on *Aphids*.

Greens

The word "greens" is used to designate the leaves and stems of certain varieties of young plants used as food. These plants were generally boiled, sometimes with a piece of bacon, and when cooked were eaten with salt and vinegar. Rather a large list of plants is used in this way, among them the following:

California Peppergrass; Cardoon, the prickly artichoke, native of the Mediterrean region; Chard, a variety of white beets, cultivated for its large leaves, leaf stalks and midribs; Chervil, a garden herb, native of Europe, of the parsley family, the young leaves of which are used for greens, soups and salads; Chicory, a perennial herb of the aster family, native of Europe and Asia, naturalized in the United States, has a dandelion-like root and heads of bright blue flowers; Chinese Amaranth; Chinese Artichoke; Chinese Cabbage; Chinese Mustard; Chives, small perennial herb of the lily family, allied to the leek and onion; Corn-salad, called also lamb's lettuce; Cress (see Index); Dandelion, a perennial or a biennial herb of the aster family with a large yellow flower, the leaves sometimes used for food; Dock, of which there are many varieties or species, but it is the leaves of the yellow dock which are used for food, Endive, of which there are numerous varieties, forming two groups, viz., the curled and narrow leaved, and the Batavian or broad leaved (see index); Globe Artichoke; Goosefoot, called also lamb's quarters, pigweed; Ice Plant, a creeping plant of the fig-marigold family; Kale, a variety of headless cabbage, yielding curled and wrinkled leaves; Lettuce; Malabar Nightshade, a slender climbing plant of the goosefoot family—care should be used in nightshade, for some varieties are poisonous; Mustard; Nasturtiums; Orache, the garden orach or mountain spinach; Parsley, much used in garnishing dishes and flavoring soups; Peppergrass; Pigweed, a plant that belongs to the goosefoot family and the variety used for greens is sometimes called "lamb's quarters;" Pokeweed, a stout, smooth,

perennial herb with large tender leaves, sometimes used as greens, but the root is more or less poisonous, is purgative, emetic and somewhat narcotic—the leaves should be used when they are young and tender; Sorrels, of which there are several varieties having a sour, acid, pleasant taste, used as pot herbs, and in the making of pies; Spinach; Turnip; Purslane, familiarly known as "pusley," a prostrate fleshy annual of the gardens and waste places of both the Old and the New World, with thick and reddish-green leaves and stems.

GREER, RALPH C. See *History of Orcharding in Old Oregon* under *Apple*.

Geese in the Orchards

It has been discovered that geese in an orchard are useful because they devour the waste fruits, generally full of worms and hatcheries for another generation of pests. This seems to have been first discovered in Canada, where the wild geese from the lakes and rivers entering the orchards cleaned up the waste fruits, and it was found that in these orchards there were fewer pests than in the orchards of adjacent communities where the geese did not enter. Later the experiment of growing tame geese in the orchards of Ohio and certain other sections was successful not only on account of the work they did in the orchards, but on account of the profit yielded in the sale of feathers and meat. Geese are easily grown and the young are not nearly so tender and likely to die as chickens. Besides, they yield good profits and do less damage to trees than swine, which are often used in the orchards for the same purpose. However, in the irrigated sections they would, during the season in which irrigation is practiced, greatly interfere with the ditches, and would from this viewpoint be objectionable. In cases where they could be cared for during the season of irrigation, or where irrigation is not practiced, it seems to the writer that they could be made useful and profitable.

GRANVILLE LOWTHER

Grapefruit or Pomelo

The fruit of a tropical tree *Citrus decumana* nearly allied to the orange. The fruit, which resembles the orange in shape, is externally pale yellow and varies in size from the smaller grapefruit or pomelo of the size of a very large orange to that of the pompelmoes, which may be eight inches in diameter.

The tree is supposed to be a native of Malay and the Polynesian islands, but is generally cultivated throughout the tropics. The leaves are like those of the orange, but downy on the under surface, as are also the young shoots. The flowers are large and white and are succeeded by very large globose-like fruits, pale in color, but with more pungent flavor than the orange.

The fruit is sometimes known as shaddock, after Captain Shaddock, who introduced it into the West Indies, also "forbidden fruit."

It is recommended by the American Pomological Society as adapted to the following districts. (See page 192.)

FOR CULTURE OF THE POMELO, see *Orange*.

District No. 6

HIGHLY RECOMMENDED — *Dessert and Market:* Aurantium; Blood; Hart; Josselyn; Mammoth; Pernambuco; Triumph; Walters.

RECOMMENDED—*Dessert and Market:* Royal.

RECOMMENDED FOR TRIAL—*Dessert and Market:* Marsh *Seedless*.

District No. 17

RECOMMENDED—*Dessert and Market:* Marsh *Seedless;* Pernambuco; Triumph.

District No. 18

HIGHLY RECOMMENDED — *Dessert and Market:* Marsh *Seedless; Triumph.*

RECOMMENDED—*Dessert and Market:* Champion; Hart.

Guam

The island of Guam belongs to the Ladrone group, east of the Philippines and west of Hawaii. It is the largest in the group and the only one with any

considerable population. It was ceded to the United States in 1898. The remainder of the group belongs to Germany. It is 29 miles long and from three to ten miles wide, and is said to have about 200 square miles of territory.

On the east side it is high and precipitous, slopes off to a low plateau on the north and is mountainous in the south.

It is estimated that about 1 per cent of the soil is now in cultivation, and that about 50 per cent, or one-half, is arable. The island is heavily wooded and except for a few clearings may be said to be an almost impenetrable jungle. The timber is valuable for fine furniture, shipbuilding and ornamental work.

The fruit industry of the island is undeveloped, although there are valuable native fruits. The cocoanut is the finest in the world, and pineapples, bread fruit, sour sop, custard apples, bananas, melons and other tropical fruits grow luxuriantly.

GRANVILLE LOWTHER

Guava

The guava is a tropical fruit of an American tree of the myrtle family. There are two varieties, the red guava and the white guava, by some regarded as distinct species. One is called *Pisidium Guaiava pomiferum;* the other *Pisidium Guaiava pyriferum.*

The fruit of the first variety or species mentioned resembles the apple, and the second resembles the pear. The name came from the Mexican guayaba. The species which produces the bulk of the guava fruit of commerce is a tree from 15 to 20 feet in height, with short-stalked or ovate leaves inclined to be oblong, strongly marked veins and covered with a soft tomentum or down. The flowers are borne on auxiliary stalks, and the fruits vary much in size, shape and color, numerous forms and varieties being known and cultivated. The variety most widely cultivated is the "white guava," whose fruits are pear shaped, about the size of a hen's egg, covered with a thin white or yellowish skin filled with soft pulp of a yellowish color and having a sweet-acid and somewhat aromatic taste.

The pulp of the apple-shaped variety, sometimes called the red variety, is darker in color and not so fine in flavor. However, both kinds are used in the making of guava jelly and guava cheese, which are manufactured in the West Indies and exported to the different countries of Europe.

Guavas are not largely grown in the United States, but experiments justify their planting in the following districts. (See page 192.)

District No. 17

RECOMMENDED—*Dessert, Kitchen and Market:* Cattley *(Strawberry). Kitchen and Market:* Chinese *(Mexican).*

District No. 18

RECOMMENDED—*Dessert, Kitchen and Market:* Cattley *(Strawberry). Kitchen and Market:* Chinese *(Mexican).*

HAWTHORNE: See *Apple, History of.*

Hazelnut or Filbert

This nut is a genus *Corylus* of shrubs and trees of the order *Cupuliferae* and grows almost wholly in the Northern hemisphere. The male flowers are long and cylindrical, a spike shape sometimes designated as ament or catkin. Hazels, alders, certain varieties of willows and poplars, have similar flowers.

Fig. 1. Native Hazelnut from the Upper Wenas, Washington.

The nut is marked at its base with a scar or cicatrix. The flowers on the stem of the hazel are developed the year preceding their appearance; the male flowers last over winter naked, the female enclosed in a bud. In early spring the male catkins elongate and produce an abundance of dry pollen, while the female flowers are distinguished from the leaf buds only by their larger size and projecting red stigmas.

The nut is enveloped at the base by a sheath of succulent leaves or bracts.

The European hazelnut, *Corylus avellana,* from cultivation has produced several varieties, differing in size, shape and flavor of the nuts which are known generally as filberts. It is easily cultivated, will grow almost anywhere, but seems to grow best on a light and rather dry soil. Perhaps the best nuts shipped into this country come from Spain, where they are carefully cultivated, and before export are baked in order to insure their good keeping.

The American hazel, *Corylus Americana,* is very like the European, but is a smaller shrub. It has not been cultivated in America, but is native to most parts of the Eastern United States.

Oil is obtained from hazelnuts that is said to be nearly equal to that of almonds and is used by chemists and perfumers as a basis for their combines.

The wood is very hard and flexible and is therefore much prized in Europe for poles, fishing rods, hoops, handles, etc.

From the Oregon Agricultural College Bulletin 111 we quote the following:

"While a great deal of interest is manifested in regard to filbert growing, few plantings have been made upon which we can make careful observations. Undoubtedly there is a considerable area of land adapted to this nut, as one finds wild species growing prolifically through Western Oregon. It is a question yet as to the best soils to use. Some believe that the clay loams will produce large trees, but not heavy bearers, and therefore will not be as profitable for filberts as other classes of soils. We find the nut growing naturally on the deep moist loams. Most authorities believe they should be encouraged to grow as a tree rather than as a bush. They should be given good cultivation and care. The best varieties are the French and Spanish, such as Barcelona and DuChilly."

GRANVILLE LOWTHER

Fig. 2. Filberts Grown in Clarke County, Washington. 1, DuChilly; 2, Barcelona. Nuts grown by A. A. Quarnberg.

Filberts in the Northwest

The filbert, or hazel, as it is often called, is best suited of all nut-bearing trees to garden culture. They are generally described as shrubs or low trees In "Nut Culture in the United States," published by the United States Department of Agriculture, it is stated:

"All are unisexual, having staminate blossoms in catkins, developed in the axils of the leaves, on the wood growth of the previous year. The catkins are visible as early as August of the previous season, and in March and April scatter the pollen freely. The pistilate blossoms compose a star-like tuft of crimson stigmas projecting beyond the short, scaly bud, the inner scales of which keep pace with the growth of the enlarging pistils so as to nearly or wholly enclose it at maturity. The pistillate blossoms sometimes bloom later in the spring than the staminate ones on the same bush, and in such cases it is necessary to supply pollen from other sources, at the proper time, to secure crops of nuts."

In Oregon and Southwestern Washington the Barcelona blossom in January and DuChilly in February

A. A. Quarnberg, the nut expert of Clarke county, Washington, says:

"The filbert is a commercial nut of much promise in the Northwest, which by climatic conditions is especially adapted to its culture The filberts consumed in the United States must either be produced in the Northwest or continue to be imported from foreign countries, as repeated efforts to raise them in Eastern and Southern states have been so discouraging that the business has now practically been abandoned. There is, therefore, a ready market for almost any amount of filberts that may be grown in this part of the country, and favorable conditions for their culture is a valuable asset and a resource worth developing.

"The industry is yet in its infancy, but is expected to advance more rapidly now that it is known that it can be made a success. The filbert is not generally known and appreciated as it deserves to be; a good filbert is mild and has a fine flavor.

"As far as known the first experimental filbert trees of European varieties were planted in Clarke county in the spring of 1894 by Nat. M. Norelius, Henry J. Biddle and the writer. In the following years others planted in small quantities, but it remained for John E. Norelius in 1900 to set out enough trees, 300 in number, to be called an orchard, and which at that time was the largest filbert orchard in the Northwest. Each year has since added to the number of planted trees so the time is not far distant when filbert culture will be numbered among the important industries of the country."

The soil and climate of Southwestern Washington and the Willamette valley have been demonstrated to be well adapted to filbert raising, by growing the largest and finest of European varieties for a number of years.

Filberts as Fillers

The filbert is well adapted to be used as a filler for walnut orchards, as it will come into bearing early and will never reach a height to interfere with the walnut trees and may be easily removed when the walnuts need all the space. They are usually grown in tree form and not as bushes when planted in commercial orchards, and are usually planted about 10 feet each way.

The thin, unfruitful twigs are removed and the fruitful limbs shortened back nearly to the female buds. Care should be taken to leave sufficient male catkins for an ample supply of pollen. The fruit spurs are near the extremities of the last year's growth, and nuts are more abundant where light and air have ready access. In the fifth or sixth year trees should bear considerable fruit Trees of this age in England are reported to produce three to four pounds of nuts each.

Successful filbert orchards are grown at Monmouth, Springfield, Eugene, Shaw, Corvallis and other points in the Willamette valley.

HAZELNUT PESTS

Hazelnut Weevil

Balaninus obtusus Blanch.

*Hazelnuts or filberts are injured in much the same manner as are chestnuts and pecans and by a similar weevil. (See *Chestnut Weevils.)* In 1891 this weevil was reported as badly damaging hazelnuts in Iowa.

The beetle differs from others which attack edible nuts, exclusive of acorns, by its shorter, more robust form and shorter beak. It is about one-fourth of an inch in length, and the beak does not exceed half the length of the body. The vestiture varies from gray to ochreous, and the elytra are moderately mottled.

This species occurs from Massachusetts and New Hampshire westward to Minnesota and Texas. Injury has been noted in Massachusetts, New York, Indiana, Iowa and Minnesota.

Remedies

Since hazels are not cultivated in this country to any extent, no remedy need be employed other than gathering entire crops and destroying isolated bushes where it is unprofitable to gather the nuts. It would be quite possible, owing to the small size of the hazel plant, to control this species by jarring, as for the plum curculio.

APPLE LEAF HOPPER. See *Apple Pests.*

HEADING TREE IN NURSERY. See *Nursery,* under *Apple.*

Hickory Nut

The hickory is a group of the walnut family *Juglans* and belongs to the genus *Hicoria* or *Carya.* It grows naturally in North America, exclusively, where it is found in several species and varieties. The trees are large, growing sometimes to 100 feet or more in height and two to three feet in diameter. Its leaves are pinnately divided and its flowers pistillate. The fruit is enclosed in a thick shell with a tough green husk which opens when ripe and permits the fruit with its shell to easily drop out.

About ten species of hickory have been tabulated by botanists, only five of which have any commercial value. These may be arranged as follows:

1. The shag bark, or white hickory, *Hickoria ovata,* a species in which large loose layers of bark form on the outside of the tree containing an oily substance which made it of value to the pioneers in the kindling of fires, or in producing a quick, intensive heat. The nuts of this species are sweeter than those of any other species, but on account of the hard shell in which the kernel is encased it has not become so popular as the pecan.

2. The black hickory, *Hicoria laciniosa,* has a shag bark, but the shags are shorter and narrower than the "shag bark," and for this reason it is called "shell-bark." It also has larger leaves and darker wood than the white hickory.

3. *Hicoria abla* is noted for the toughness and hardness of its wood. It is sometimes called "broom hickory" because the frontier settlers where it grew cut the young saplings and made them into brooms.

4. *Hickoria glabra,* or "pig nut," represents a species that grew along the streams or in wet lands whose nuts were elongated in form, bitter in taste and covered with a thin husk.

5. *Hicoria pecan.* For a description of this species see *Pecan.* The other species being of little commercial value are not treated in this article.

HICKORY DISEASES

Leaf Spot

Marsonia juglandis (Lib.) Sacc.

According to Selby this disease is quite general in Ohio, causing a premature dying of the leaves.

Requires further study.

Root Rot

Several species of root rot similar to those attacking the apple and other fruit trees are responsible for the dying of hickories.

HICKORY NUT PESTS. See *Pecan Pests.*

* Bureau of Entomology Circular 99

Horseradish

Horseradish is known botanically as *Cochlearia amoracia.* It is a perennial plant of the natural order *Cruciferae,* having a stout cylindrical root, from the crown of which spring large radical leaves on long stalks four to six inches broad and about a foot in length. It is indiginous to Eastern Europe and has been grown for many centuries.

The root, which is the part used commercially, is from a half inch to two inches in diameter, and from one foot to three feet in length. It has numerous lateral branches which when started in a field or garden make it very difficult to eradicate.

It is dried or grated and canned, or in other ways preserved, and used as a flavoring agent on meats, in vinegars, etc. As a medicine, it is anti-scorbutic.

The following is from the Fruit-Grower and Farmer, and is a good description of the methods of production and handling:

"Horseradish requires a good soil, prepared in about the same manner as for corn. The plants withstand considerable drought and are practically frostproof. In fact, frost even adds to the flavor of the horseradish. The crop is propagated from root cuttings and from 10,000 to 15,000 are required to an acre. The roots are planted 18 inches apart in the row and about 3 feet between rows. In planting it is important to be sure to turn up the top end of the cutting, otherwise the root will be crooked and not so marketable. Set the roots in a slightly slanting position and cover two or three inches deep. Cultivate as often during the summer as is needed to stimulate growth, keep down weeds and conserve the soil moisture.

"The best root cuttings are about the size of a lead pencil and eight or nine inches in length. As there is usually very little taper to them, it is best to cut the lower end slanting and the upper end square across, so as to distinguish which end to put down.

"The horseradish season lasts the year through to some extent, but is most active during the oyster season. Harvesting begins about November 1st, although earlier in some sections, and requires a great deal of hand work. There is one good feature, however, in that the crop may be left in the soil without injury from freezing, and be dug as needed.

"An extensive grower near St. Joseph, Missouri, has two large storage caves, each about 200 feet long, with a shaft in the center leading to the outer air. The roots are hauled and dumped in the shaft and then scattered each way in the cave below. Here they keep perfectly and may be marketed at whatever time they are wanted.

"The most profitable way to market horseradish is for the grower to grind the roots and pack the pulp in wide-mouthed bottles. There are a number of grinders or graters on the market for this purpose. Some are operated by hand and some by machine power, and either kind can usually be obtained from the local hardware man.

"The bottles usually used for packing horseradish are of eight ounces capacity, and of such size it will usually require about 6,000 to 8,000 to contain the crop of one acre of horseradish roots. The retail price of bottles this size is about 10 cents each, or 80 cents a dozen at wholesale.

"In preparing the roots for grinding, they are at first washed and peeled. After grinding, the pulp is mixed with diluted malt vinegar at the rate of about six gallons of vinegar to a bushel of pulp. This quantity will about fill 18 dozen eight-ounce bottles. Malt vinegar is considered very essential for packing horseradish, as cider vinegar will turn the product dark and makes it unsalable. As malt vinegar is generally too sharp, it is customary to dilute it, using three parts water to one part of malt vinegar, where the vinegar is about 110 proof. More or less water may be required, according to the strength of the vinegar. It is always best to go by the taste of the packed product, rather than by any specific recipe, as the important thing is to maintain the piquancy of the horseradish as the prominent character-

istic, rather than the sharp acidity of the vinegar.

"Horseradish mixed with vinegar, mustard, spices and salt is a condiment that has considerable favor in some markets. It keeps longer than the horseradish alone.

"After bottling, put in the corks, then cover the top with sealing wax so as to make the bottle air-tight. This aids in keeping the contents white and piquant, whereas, if the sealing wax is omitted, there will be enough air filter through the cork to darken the upper part of the horseradish in a short time. If a restaurant or hotel trade is to be supplied, it will pay to furnish the horseradish in bulk or in quart or half-gallon, screw-top jars. In larger cities this is done with profit."

HORSERADISH DISEASES

Brown Spot

Alternaria brassicae (Berk.) Sacc.

Occurs in Europe and America upon cabbage and horseradish, producing brown spots with concentric markings.

This disease may be controlled by thorough spraying with Bordeaux.

Reference

Duggar. Fungus Diseases of Plants.

Root Rot

Thielavia basicola (B. & Br.) Zopf.

This disease attacks a variety of plants in addition to horseradish, among them the lupines, tobacco, and the violet. The distribution seems to be from Ohio eastward in the United States and in Europe.

The attack is especially severe in seed beds. The roots fail to develop normally. The roots may be browned and roughened on the outside, but the fungus penetrates to all parts of the interior of the root.

It is thought that this disease is almost constantly associated with an alkaline soil. Thorough aeration and general sanitary measures are required.

Reference

Duggar. Fungus Diseases of Plants.

White Rust. See *Cabbage Diseases.*

HORSERADISH PESTS

Cabbage Worm. See *Cabbage Pests.*

Harlequin Cabbage Bug. See *Cabbage Pests.*

Western Army Worm. See *Beet Pests.*

Hop Aphis on Plum. See *Aphids.*

Horticulture

Horticulture is a department of the science of agriculture. Agriculture is the larger term and includes the growing of cereals, grasses, farm products and all kinds of vegetation useful to mankind. Horticulture is used in a restricted sense, and is that department of agriculture which treats of the growing of fruits, vegetables, flowers and ornamental plants. Horticulture may, therefore, be divided into pomology or the growing of fruits, olericulture or vegetable gardening, floriculture or the raising of ornamental plants for their individual uses or for their products, and landscape horticulture or the growing of plants for their uses in the landscape. Practically, horticulture will treat of the adaptations of horticultural plants to certain varieties of soil, climate, altitude and general environmental conditions.

Fruit Growing

Why is fruit growing more difficult than other branches of agriculture?

First: It is more difficult because the fruit tree is more highly organized than the grasses, the cereals, and the root crops. The higher and more complex the organization the greater the difficulty in understanding it. Just as a machine with a larger number of parts requires more careful study than one less complex, so the tree that is more highly organized requires more careful culture and handling.

Second· The fruit of the tree, which is the part of value, is tenderer than the valuable part of hay, corn, wheat, potatoes, oats, and other farm products. It must, therefore, be handled with greater care. In handling apples and peaches, for instance, each one must be carefully handled without bruising, while hay can be handled with a fork, and potatoes,

wheat, oats and corn with a shovel without injury from rough usage.

Third: Fruits are consumed for the most part raw or in their original form and even the beauty and attractiveness of the raw product makes a great difference in the price, while with products grown for stock, such as hay, corn, etc., or products grown for human food where the grinding or cooking destroys the original forms, the uniformity of color and shape is of less consequence.

Fourth: The fruit tree, being more highly organized, is sensitive to favorable or unfavorable conditions of soil, climate, winds, frosts, sunlight, and humidity. For instance, a species of grass will be less injured by heat or cold, will be less affected by rain or sunlight, than fruits; while spring frosts come at a time when cereals, grasses and root crops are not likely to be injured, and at a time when the blossoms are forming on the fruit tree and in danger of destruction. It is, therefore, necessary to select a site for the orchard where the blossoms are not likely to be killed by spring frosts. This makes wind currents, air drainage, elevation, and evaporation from large bodies of water factors in the selection of orchard sites.

Fifth: The coloring of fruits is a factor in their commercial value, while in grasses, grains and root crops it is a negligible quantity.

Sixth: The form of the fruit, even, makes a difference in the value, while picking, assorting and packing are arts requiring great discrimination, rapidity of motion, and a degree of intelligence not so necessary in the handling of most other farm products.

Seventh: The diseases of fruit trees, insect pests, and their remedies present a field for study, investigation and skill that is equalled only by the study of diseases and cures of the human family. Tree pruning or surgery are subjects related to the surgery and cure of diseases in the animal kingdom.

Eighth: The marketing and shipping of fruits are much more complex than the same transactions with reference to hay or grain. For instance, it is never necessary to put hay in cold storage preparatory to shipment or to precool it or ship it in refrigerator cars. Neither is it necessary to protect it from extreme cold to prevent freezing. Hay can be shipped in bales and grain in sacks, while fruit must be shipped in barrels, boxes or crates and handled with great care.

Ninth: In the use of the by-products of fruit, such as cider, vinegar, canned goods, dried fruits, jellies, jams, butters, etc., there are many subjects for study.

Upon the whole, horticulture will, in the necessities of the case, be regarded as a profession, and while the student will be a worker in the field, he must also, part of the time, pursue his studies in the library and the laboratory; while he will gain practical information by contact with living things, he will interpret them by the experience of the past and through the information gained largely from books, and by means of the apparatus of the scientific laboratory.

GRANVILLE LOWTHER

HORTICULTURAL LAWS, OREGON AND WASHINGTON. See *Laws*.

List of Secretaries of Horticultural Societies

American Nurserymen's Association—Geo. C. Seager, Rochester, N. Y.
American Florists Association—W. N. Rudd, Morgan Park, Ill.
American Pomological Society—L. L. R. Taft, Lansing, Mich , Treasurer
American Civic Association—Clinton Rogers Woodruff, Philadelphia, Pa
American Apple Growers' Congress—T. C. Wilson, St. Louis, Mo.
American Rose Society—Benjamin Hammond, Fishkill-on-Hudson, N. Y.

State Horticultural Societies

Arizona—R. H. Forbes, Tucson.
Alabama—P. F. Williams, Auburn.
Arkansas—Prof. Ernest Walker, Fayetteville.
British Columbia Fruit Growers' Association—W. J. Brandrith, Ladner, B. C.
California State Floral Society—Mrs. Henry P. Tricon, San Francisco.
California—H. H. Lillienthal, San Francisco.
Colorado State Board of Horticulture—D R. Statler, Secretary, Capitol, Denver, Colo
Colorado State Horticultural Society—Martha A Shute, Denver, Colo.
Connecticut Pomological Society—H. C. C. Miles, Milford
Connecticut—H. C. C Miles, Milford.

Delaware, Peninsula Horticultural Society—Wesley Webb, Dover, Del.
Florida—E. O. Painter, Jacksonville.
Georgia—J. B. Wright, Cairo.
Idaho State Horticultural Society—Frank F. Pierce, Fayette, Idaho.
Illinois—W. B. Lloyd, Kinmundy.
Indiana—C. G. Woodbury, Lafayette.
Indiana—W. N. Yost, Meridian.
Iowa—Wesley Greene, Davenport.
Kansas—Walter Wellhouse, Topeka.
Kentucky—W. R. Button, Bedford.
Louisiana—F. H. Burnette, Baton Rouge.
Maine—E. L. White, Bowdoinham.
Maryland—Prof. C. P. Close, College Park.
Massachusetts—William P. Rich, Boston.
Massachusetts Fruit Growers' Association—F. Howard Brown, Marlboro, Mass.
Michigan—Charles E. Bassett, Fennville.
Minnesota—A. W. Latham, Minneapolis.
Mississippi—H. E. Blakelee, Jackson.
Missouri—Dr. W. L. Howard, Columbia.
Montana—M. L. Dean, Missoula.
Nebraska—C. G. Marshall, Lincoln.
New Hampshire—B. S. Pickett, Durham.
New Jersey—Howard G. Taylor, Riverton.
New Mexico—J. D. Sena, Santa Fe.
New York—E. C. Gillett, Penn Yan.
Western New York Horticultural Society—John Hall, 204 Granite Building, Rochester, N. Y.
North Carolina—Prof. W. N. Hutt, West Raleigh.
North Dakota—O. O. Churchill, Agricultural College.
Northeastern Iowa Horticultural Society—Chas. F. Gardner, Osage, Iowa.
Northwestern Iowa Horticultural Society—W. B. Chapman, Washta, Iowa.
Northwest Fruit Growers' Association—H. J. Williamson, Portland, Ore.
Ohio—F. H. Ballou, Newark.
Oklahoma—J. B. Thoburn, Oklahoma City.
Oregon—Frank W. Power, Portland.
Oregon State Board of Horticulture—H. M. Williamson, Portland, Ore.
Oregon State Horticultural Society—H. C. Atwell, Secretary, Forest Grove, Ore.
Ontario Fruit Growers' Association—P. W. Hodgetts, Toronto, Ont.
Pomology and Fruit Growers' Society—Peter Reid, Chateonguay Basin, P. Q.
Pennsylvania—Chester J. Tyson, Floradale.
Rhode Island—Arthur C. Miller, Providence.
Royal Horticultural Society—F. J. Crittenden, Esq., F. L. S., Vincent Square, Westminster, S. W. England.
South Dakota—Prof. N. E Hansen, Brookings.
Tennessee—Prof. Charles A. Keffer, Knoxville.
Texas—Prof. E. J. Kyle, College Station.
Utah—J. Edward Taylor, Salt Lake City.
Vermont—M. B. Cummings, Burlington.
Virginia—Walter Whately, Crozet.
Washington—R. E. Trumbull, Wenatchee.
Western Horticultural Society—F. W. Brodrick, Agricultural College, Winnipeg, Man
West Virginia—A. L. Dacy, Morgantown.
Wisconsin—F. Cranefield, Madison.
Wyoming—Aven Nelson, Laramie.

HOTBEDS. See *Vegetable*.

HUCKLEBERRY. See *Blueberry*.

HUDSON'S BAY COMPANY. See *History of Orcharding in Old Oregon*.

HUMUS. See *Cover Crop, Apple Orchard*.

Idaho

The altitude of Idaho varies from 738 feet at Lewiston, to 12,078 feet at Hyndman Peak, and its mean elevation is about 4,500 feet.

The Snake river, which rises in the Yellowstone National Park, is, with its tributaries, the principal drainage system of the state. A small portion drains into Great Salt lake in Utah, and a larger portion into the Pend d'Oreille, Kootenai and Spokane rivers in the north, which empty into the Columbia. The Snake river is also a tributary of the Columbia.

In the northern part of the state crops are grown successfully without irrigation and the hardier varieties of apples and small fruits succeed well. Generally the apple orchards of this region are planted on lands where there is considerable humus, and the water percolates through the soil from the lands of higher elevation and furnish a system of subirrigation so that surface irrigation is unnecessary. In the southern part the conditions are arid or semi-arid, the rainfall varying from 9 to 17 inches, but there are irrigating projects that bring the Snake river into prominence as the source from which a large agricultural and horticultural region can be watered. Perhaps the oldest fruit-growing districts are the Boise, Payette and Weiser valleys. The soil is mostly a volcanic ash, sometimes of immense depth, and when well watered may be made very productive.

The largest crops grown in Idaho are hay, wheat and potatoes. Next in importance comes stock raising. The fruit industry is not as large as in some of the sister states west of the Rockies, but there are large areas where this industry can be made commercially profitable and where it is rapidly growing into importance.

GRANVILLE LOWTHER

Table Showing Idaho's Irrigated Lands

COMPILED BY HERBERT HALE,

Assistant Commissioner of Immigration, Labor and Statistics, State of Idaho.

County—	No. Acres Under Canal Systems.	No. Acres Actually Irrigated.	Length of Canal.	Cost of Construction.
Ada	196,667	94,000	213	$ 1,207 000
Bannock	129,360	70,964	417	375,500
Bear Lake	41,744	31,624	194	76,100
Bingham	758,940	458,320	1,938	3,012,532
Blaine	335,764	210,650	850	4,431,430
Boise	41,349	22,161	268	166,650
Bonner	1,000	710	10	2,500
Canyon	128,905	92,090	1,241	3,003 930
Cassia	25,183	18,700	138	52 320
Custer	6,580	3,690	112	13,850
Elmore	110,837	34,706	90	536,725
Fremont	523,864	236,985	1,435	1,432,240
Idaho	7,616	3,950	75	41,550
Kootenai	8,060	6,620	29	226,000
Latah	....	....	....	....
Lemhi	31,025	21,169	120	71,063
Lincoln	33,041	12,595	270	136,668
Nez Perce	7,180	5,940	41	316,500
Oneida	156,176	93,285	634	1,000,712
Owyhee	126,000	6,514	102	168,000
Shoshone	....	....	....	....
Twin Falls	242,130	201,150	681	4,003,231
Washington	43,388	30,070	170	218,770
Total	2,954,608	1,656,593	9,021	$20,491,771

HORTICULTURE IN IDAHO

Commercial Orcharding

Fruit growing on a commercial scale in Southern Idaho is confined chiefly to the Boise, Payette and Weiser valleys. The Snake river canon offers particular advantages for the culture of peaches and grapes. Council valley is one of the newer fruit districts that promises well. Other sections will no doubt grow fruits commercially.

The majority of our new lands may be planted to orchards without any previous cropping. Some soils, however, should be thoroughly subdued by the culture of alfalfa before planting. The successful starting of an orchard requires special attention to the essential things, which are thorough preparation of the land, the selection of good trees full of vigor, careful planting, the use of water in setting and proper topping of the trees. Too much care cannot be exercised in these operations.

Frequent cultivation of the orchard the first year and later years, and the application of water in such amounts and at such times as the soil conditions will demand are necessary for satisfactory growth of the trees.

Irrigation should cease in time for the maturing of the trees before the first frosts occur in the fall.

When the orchard reaches the bearing age it is necessary to seed to red clover for the purpose of adding nitrogen and humus, and improving the physical condition of the soil. The clover is allowed to remain two years, when it is plowed up, and two years of clean cultivation follow, after which the orchard is again seeded to clover. The training and pruning of the trees aims to produce trees sufficiently strong in their main scaffolding to support the loads of fruit, and as low-headed as practicable to reduce the cost of spraying, pruning and picking. In pruning, due attention should be given to the different requirements of different fruits and even of different varieties, in order that a regular fruiting habit be induced and maintained.

Careful handling of the fruit, proper grading and honest packing with attractive packages all make for a ready sale and satisfactory prices. In the marketing there is a great advantage in cooperation, and local fruit growers' associations are a necessity.

Apples

The apple is the leading fruit, with the prune second. The planting and care of

the orchard up to and including the fifth year is about $125 per acre. The fifth year the trees should yield a box to the tree and may pay for the expense of that year and a little more. From this year on the yields will increase until the tenth year, when they usually reach full bearing and produce eight to ten boxes per tree. A full-bearing orchard should give a net profit per acre of from $150 to $400. The orchardist should always average more than $100 profit per acre per year and a profit of $500 to $600 per acre is not uncommon. The leading varieties are Jonathan, Rome Beauty and Winesap.

Prunes

The Italian prune is the variety that is grown commercially. It comes into bearing the fifth year, or may bear a little the fourth year. It costs about $100 per acre to bring the prune orchard into bearing. Full bearing is reached about the eighth year, when the trees should produce 200 pounds, or eight crates of fruit each, making ten tons per acre, which should give a gross income of $150 per acre, or a net profit of about $110 per acre, assuming that the prunes are sold on the trees. This is a conservative statement, as under favorable conditions the profits may exceed $200 per acre.

Peaches

Being somewhat more susceptible to injury from frost, the peach has not as wide an adaptability as apples, pears and prunes. Its culture will therefore be very largely confined to the favored locations such as the Snake River canyon and certain foothill locations in the lower valleys. Peaches should bear some fruit the third year. The sixth year they should give a net profit of from $200 to $500 per acre. The Alexander, Early Crawford, Elberta, Champion, Sulway and Late Crawford are the leading varieties grown.

Other Orchard Fruits

The culture of the pear is much like the apple and the profits are about the same. The best varieties are the Bartlett, Flemish Beauty and Anjou. Sour cherries may be grown everywhere and are a profitable crop, netting about as much per acre as peaches. Sweet cherries may be grown in the more favored localities. Plums are grown everywhere in family orchards and produce well.

Lewiston has, perhaps, the most favorable climate for the production of the less hardy fruits. Sweet cherries, peaches and grapes are grown there on a commercial scale.

Small Fruits

At Lewiston the European grapes are grown quite extensively. It costs about $165 per acre to bring vineyards into bearing. The expense of producing a crop is about $75 per acre, and the net returns are about $350 to $400 per acre. The varieties grown are Flame Tokay, White Malaga, Raninnania and Black Cornichon. In Southern Idaho the European sorts can be grown only in the most favored locations, while the American grapes, such as Concord, Diana, Worden, Niagara, Sweetwater, Moore's Early and Brighton, may be grown successfully all through Boise, Payette and Weiser valleys and in the more protected locations as far eastward as Twin Falls and possibly farther. Gooseberries and currants succeed well everywhere, but they are as yet grown chiefly for home use. Black raspberries and dewberries are grown commercially and are very profitable. Strawberries easily net $200 to $400 per acre.

Horticultural Statistics

Two years ago the prophecy was made that the planting in the succeeding two years woud be greater than any previous time in the history of the state, and the results have more than fulfilled this prophecy. The reports of the deputy inspectors show that there has been about 20,000 acres increase in the orchard acreage of the state. In the main, this new planting has been wisely and carefully done. The lands selected usually have been adapted to fruit culture and the varieties have been wisely chosen.

The shipments of fruit have also increased rapidly. The crop of 1910 was the largest in the history of the state. The value of the fruit crop shipped out of the state in 1910 is estimated at about $2,500,000—2,000 cars of apples, with a value of $1,750,000; 600 cars of prunes, with a value $400,000; other tree fruits and small fruits making up the remainder of the total of $2,500,000. With the coming into bearing of thousands of acres of young trees in all parts of the state, the total fruit production will rapidly increase.

Table Showing the Acreage of Commercial Orchards in the Counties Named

County	Acres
Ada	8,000
Bannock	1,000
Bear Lake	1,000
Bingham	1,500
Blaine	1,000
Boise	1,000
Bonner	2,500
Canyon	9,000
Cassia	1,000
Custer	500
Elmore	2,000
Fremont	1,000
Idaho	6,500
Kootenai	3,000
Latah	1,500
Lemhi	500
Lincoln	4,000
Nez Perce	5,000
Oneida	1,000
Owyhee	1,000
Shoshone	1,000
Twin Falls	4,000
Washington	4,000
Total	61,000

ELIAS NELSON

VARIETIES OF APPLES FOR IDAHO

Selection of Variety

Varieties that may be well adapted to home uses may be decidedly lacking as commercial sorts. Tender fruits are not adapted to shipping to distant markets because they bruise easily, consequently their keeping qualities are poor. Color and size are essential in good market apples, while these elements are not as important as quality for home use. Naturally then the selection of the kinds of apples depends upon the use to which the orchard is to be devoted, whether for productive apples for home use or for market purposes.

Kinds That Sell Best

An inquiry into the market will show that the apples finding readiest sale at highest prices are fairly large and highly colored. No color seems to meet the customer's fancy quite so well as a clear bright red, although a few yellow sorts of known quality are also in demand. It does not necessarily follow that such apples are sold in greatest quantities, but it does mean that they should bring large returns to the grower. Where freight rates are high, as they are on Western apples, this is an additional reason necessitating high market prices for this product. The people who have money for the purchasing of fine fruit are also endowed with an understanding of the merits of the leading varieties, and are quite particular in their demand for certain kinds. As a general rule these people have been accustomed to apples all their lives, and this experience has developed an acquaintance not only with the merits of these varieties but also with the season of the year when each kind is at its prime. While they would not hesitate at paying a good round price for a box of Jonathans at Christmas time they would display considerable reluctance when offered the same box a month later even at a reduced price. The same is true of other varieties. The point is that in selecting varieties the orchardist must taken a long look into the future and weigh well the bearing which the season of ripening and the present acreage now planted to a variety will have upon the returns of the orchard he is now planting. The aim of orchardists should be to keep the market well supplied with the best varieties for all seasons, not to overstock the market at one season and at another furnish an insufficient supply.

Most Popular Varieties

At present the most popular varieties of apples produced in Idaho and selling on the Eastern and European Markets are the Jonathan, Rome Beauty, Winesap and Grimes. In the warm valleys under irrigation in Southern Idaho

and at the lower elevations in other parts of the state, these varieties attain the highest degree of perfection. With the exception of the Winesap, which requires a long season to mature, all are adapted to the "Panhandle" section of Northern Idaho. It is thought by some that the McIntosh Red and the Wagener are better adapted to Northern Idaho than the Rome Beauty. They are undoubtedly popular sorts and should be planted where seasons are short and where early maturing varieties are desired. The proportion of each variety to be planted deserves careful attention. In the warm valleys it is perhaps best to devote only one-third of the orchard to early winter sorts, such as the Jonathan and Grimes, with the other two-thirds equally divided between Rome Beauty and Winesaps, which are late winter varieties. In sections where the growing season is short and the early winter varieties really become late winter sorts, and the fall varieties such as Wagener and McIntosh Red come into season in early winter, the same ratio should be maintained. It will be noted that only a few varieties have been mentioned and this has been done advisedly. The most common mistake made by commercial orchardists is in planting too many varieties. Instead of confining their attention to the best of a list of varieties adapted to a locality, they plant of each kind, so that when harvest time comes they have more expense and trouble than is necessary to handle the same quantity of a few selected varieties

For Home Use

The choice of apples for home use and local market offers opportunity for personal preference to a large degree. Almost any of the varieties that have proven themselves well adapted to home use and local markets in other sections of the United States can usually be grown successfully in Idaho. If one has developed a particular fondness for special sorts those are the ones he should plant, not only because their quality suits, but because they are likely to get better attention. However, for the sake of those who may be unacquainted with any varieties, the following list has been prepared, classing them according to the season of ripening: For early summer—Early Harvest, Yellow Transparent, Red June, Red Astrachan; for midsummer—Oldenburg, Benoni, Sweet Bough, Chenango; for fall—Wealthy, Maiden Blush, Jefferis, Gravenstein, Mother, Fall Pippin, McIntosh, Tompkins King; for early winter—Jonathan, Grimes, Yellow Bellflower, Delicious, and for late winter—Spitzenburg, Stayman Winesap, Aiken, Winter Banana, Rhode Island Greening, York Imperial, Roxbury Russet, Ben Davis.

J. R. Shinn,

Idaho Experiment Station, Better Fruit, January, 1912

For additional information on Orchard Sites and Soils, see *Selection of Site* under *Apple Orchard*.

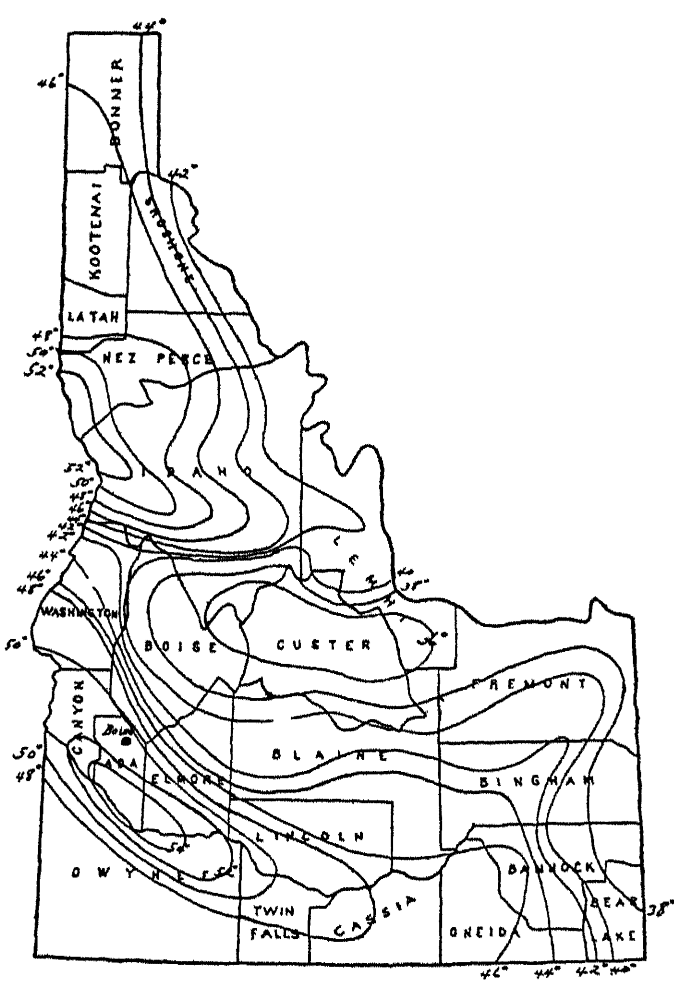


Fig 1. Map of Idaho. Showing Normal Annual Isotherms Based on the Records of the United States Weather Bureau. The Isothermal lines represented here indicate the mean annual temperature of the territory through which they pass.

Frost and Precipitation in Idaho

Station	No.	Frost				Precipitation
		Average Date of		Date of		
		First Killing in Autumn	Last in Spring	First in Autumn	Last in Spring	Annual inches
Post Falls	1	Sept. 17	May 22	Aug. 29	July 9	24.6
Murray	2	Sept. 18	May 30	Aug. 14	July 17	40.4
Moscow	3	Oct. 2	May 10	Sept. 6	May 30	23.6
Lake..	4	Aug. 29	July 2	Aug. 15	July 27	16.4
Payette	5	Sept. 26	May 10	Sept. 7	June 5	12 1
Boise...	6	Oct. 24	May 3	Oct. 2	June 5	12.9
Soldier.	7	Aug. 29	July 4	Aug. 5	July 26	13.2
Blackfoot	8	Sept. 12	May 29	Aug. 22	July 5	8.0
Garnet...	9	Oct. 20	April 22	Sept. 26	May 4	6.3
American Falls.	10	Sept. 14	May 28	Sept. 3	July 1	12.4
Pocatello .	11	Oct. 11	April 10	Sept. 26	May 2	9.8
Chesterfield	12	Aug. 10	July 21	Aug. 1	July 30	10 8
Oakley..	13	Sept. 7	June 5	Aug. 22	July 7	8 0
Lewiston	..	Oct. 27	April 8	Oct. 10	April 29	14.68

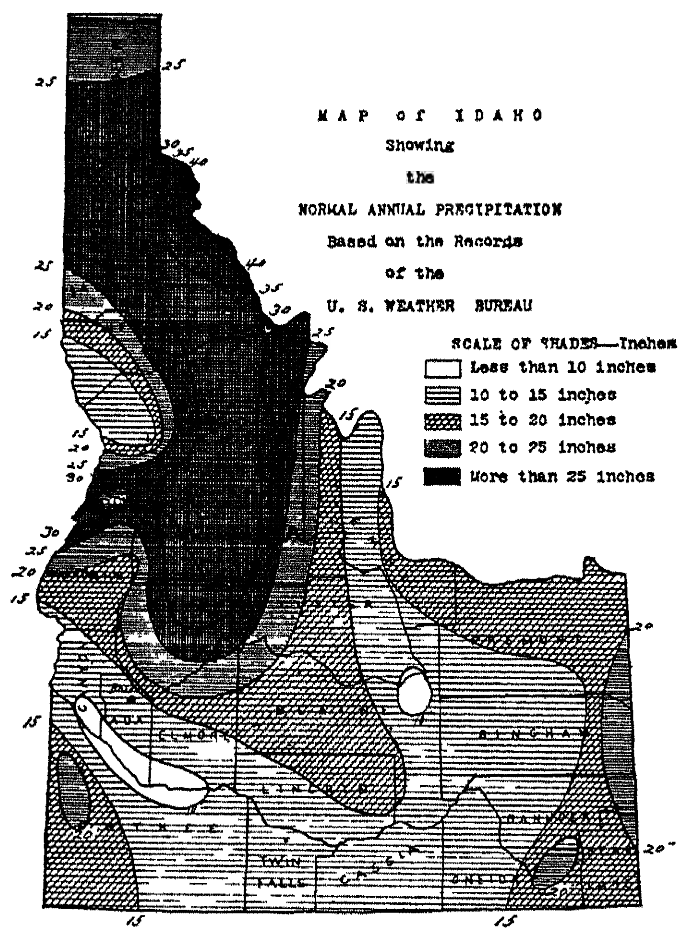


Fig 2 Map of Idaho Showing Normal Annual Precipitation Based on the Records of the United States Weather Bureau

IDENTIFYING VARIETIES, METHOD OF. See *Apple Nursery.*

Illinois

There is more good farming land in Illinois, in proportion to the area, than in any other state in the Union, unless it may be Iowa. From a horticultural viewpoint, the principle productions for commercial purposes are in the southern part of the state, south of a line beginning at St. Louis, Missouri, and extending to Vincennes, Indiana. Some authorities claim that the southern one-third of the state should be included in the area of commercial apple production and this I grant is possible; but practically I would include only about one-fourth of the state, and that mainly the southern counties. Even in this region the planting of new orchards is not as extensive as 25 years ago. As I traveled through from St. Louis to Evansville, Indiana, I counted 83 orchards that seemed to be more than small home orchards. Of that number, I saw but one that was less than three years old, and only two that looked to be over three and under ten years old More than half of the family orchards were old, the trees in an unhealthy condition, and new trees are not being planted to keep up the original number.

This is true in other states as well as in Illinois, and accounts in part for the fact that the United States census shows that in 1900 Illinois had 13,430,006 bearing trees, while in 1910 they had 9,900,627, making a loss in 10 years of 3,529,379.

This loss is said to have occurred on account of the injuries from scale, which became widespread several years ago, and which at that time they did not know how to control. Since the discovery of the lime-sulphur solution as a remedy for scale, the best orchardists now spray their trees and the orchards show every sign of vigor, health and profitable bearing.

The soil of this section is especially adapted to apples, being a clay subsoil and containing a considerable admixture of lime and humus. The climate, too, is good and all the natural conditions for the profitable growing of commercial fruit are present. In the southern one-third of the state the rainfall will range from 40 to 60 inches per annum.

The region is also adapted to the growing of peaches, plums, pears, grapes, cherries, strawberries, blackberries, raspberries, pecans, walnuts and vegetables, but the apple is the principal commercial crop. In the central and northern parts we have not discovered that fruits are grown extensively for commercial purposes, except perhaps in Madison, Calhoun, Pike, Adams and Hancock counties, along the Mississippi river, and in Jasper and Fayette counties in the south-central part of the state. The total land area of Illinois is 56,000 square miles, or 35,840,000 acres. Its extreme length is 385 miles, its breadth 285 miles. Its greatest elevation is 1,150 feet above the sea, its mean elevation 550 feet. The greater part of Illinois is level or rather undulating prairies. There are a few hills in the extreme northwest and bluffs along the Mississippi and Illinois rivers. Almost the whole state is arable and the soil unusually productive. On account of its level surface it is easy to build railroads, and, having the second largest city on the continent, there is a ready market for its products.

Fruit Statistics of Illinois

The fruit trees and vines of Illinois, according to the census of 1910, are: Bearing apple trees, 9,900,627; peaches and nectarines, 2,860,120; pears, 786,349; plums and prunes, 600,087; cherries, 843,283; grapes, 2,170,340 vines; small fruits, 11,723 acres; nuts, 85,428 trees.

The counties that produce the largest number of apples are: Adams, 223,534 bearing trees; Calhoun, 348,888; Clay, 448,859; Fayette, 240,640; Hamilton, 226,042; Marion, 622,234; Pike, 227,296; Richland, 388,125; Union, 203,496; Wayne, 278,942.

The county producing the largest number of peaches is Marion with 177,474 bearing trees.

The county producing the largest number of pears is Marion with 103,638 bearing trees.

GRANVILLE LOWTHER

Small Fruits—1909 and 1899

The following table shows data with regard to small fruits on farms:

CROP	Number of farms reporting 1909	Acres 1909	Acres 1899	Quantity (quarts) 1909	Value 1909
Small Fruits, total	....	11,723	16,794	13,602,676	$1,109,747
Strawberries	10,311	5,410	7,113	8,031,824	613,917
Blackberries and dewberries	14,138	3,503	5,032	2,915,473	237,058
Raspberries and loganberries	8,156	1,945	2,909	1,834,337	191,401
Currants	3,635	252	640	265,858	21,863
Gooseberries	8,131	603	491	541,498	44,238
Cranberries	166	10	1	13,418	1,248
Other berries	1	(1)	608	268	22

[1]Less than 1 acre.

Strawberries are by far the most important of the small fruits grown in Illinois, with blackberries and dewberries and raspberries and loganberries ranking second and third, respectively. The total acreage of small fruits in 1909 was 11,723 and in 1899, 16,794, a decrease of 30.2 per cent. The production in 1909 was 13,603,000 quarts as compared with 26,129,000 quarts in 1899, and the value $1,110,000, as compared with $1,293,000.

Orchard Fruits, Grapes, Nuts, and Tropical Fruits—1909 and 1899

The following table presents data with regard to orchard fruits, grapes, nuts, and tropical fruits. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product		
					1909		1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total	....	15,033,743	....	3,919,267	4,939,211	$3,857,743	9,767,211
Apples	160,215	9,900,627	60,631	2,548,301	3,093,321	2,111,866	9,178,150
Peaches and nectarines	114,165	2,860,120	34,411	739,358	1,222,570	999,516	66,805
Pears	68,556	786,349	25,593	234,037	249,365	202,965	133,745
Plums and prunes	69,352	600,087	18,468	141,480	78,566	80,384	157,941
Cherries	104,808	843,283	30,137	239,605	287,376	453,474	204,279
Apricots	4,996	12,328	1,514	4,246	1,250	1,457	1,437
Quinces	7,560	30,804	2,547	12,180	6,723	8,037	(2)
Mulberries	17	145	1	60	40	44	(2)
Unclassified	....	....	....	....	....	....	[3]24,854
Grapes	75,818	2,170,340	11,469	287,734	16,582,785	426,468	20,009,400
Nuts, total	....	[4]85,428	....	[4]35,666	[4]714,478	[4]20,550	360,680
Persian or English walnuts	87	772	12	1,045	3,497	331	....
Pecans	755	28,330	218	8,223	107,069	10,301	41,380
Black walnuts	1,792	44,159	280	24,698	530,730	7,411	(2)
Butternuts	49	253	3	17	3,515	76	(2)
Chestnuts	59	678	22	1,315	4,833	321	(2)
Hickory nuts	363	10,805	16	223	60,124	1,954	(2)
Unclassified	....	....	....	....	....	....	[3]319,300
Tropical Fruits, total	....	[5]271	....	[5]237	....	[5]86	23
Figs	21	124	11	201	1,008	26	23

[1] Expressed in bushels for orchard fruits and pounds for grapes, nuts and figs.
[2] Included with "unclassified."
[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."
[4] Includes almonds, hazelnuts, Japanese walnuts, filberts, beechnuts, Siberian nuts and other nuts.
[5] Includes Japanese persimmons.

The total quantity of orchard fruits produced in 1909 was 4,939,000 bushels, valued at $3,858,000. Apples contributed about three-fifths of this quantity; peaches and nectarines ranking next in importance. The production of grapes in 1909 amounted to 16,583,000 pounds, valued at $426,000, and that of nuts to 714,478 pounds, valued at $20,550.

The production of all orchard fruits together in 1909 was 49.4 per cent less in quantity than in 1899, and the production of grapes also declined. The value of orchard fruits, however, increased from $3,779,000 in 1899 to $3,858,000 in 1909, and that of grapes from $383,000 in 1899 to $426,000 in 1909. It should be noted in this connection that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits, and the like, and may therefore involve some duplication, while the values shown for 1909 relate only to the products in their original condition.

Frost and Precipitation in Illinois

Station	Frost				Precipitation
	Average Date of		Date of		
	First Killing in Autumn	Last in Spring	First in Autumn	Last in Spring	Annual inches
Winnebago	Oct. 2	May 2	Sept. 18	June 6	32.6
Chicago	Oct. 16	May 1	Sept. 18	June 8	33.4
Galva	Oct. 12	April 29	Sept. 29	May 31	33.2
Ottawa	Oct. 7	April 23	Sept. 19	May 21	36.7
Peoria	Oct. 19	April 12	Sept. 29	May 11	34.7
Bloomington	Oct. 7	April 27	Sept. 18	June 6	36.1
Griggsville	Oct. 19	April 19	Sept. 29	May 23	37.0
Springfield	Oct. 16	April 20	Sept. 25	May 22	37.4
Philo	Sept. 24	May 3	Sept. 14	June 6	36.0
Greenville	Oct. 15	April 14	Sept. 19	May 6	39.5
Olney	Oct. 16	April 20	Sept. 30	May 14	38.8
Tilden	Oct. 16	April 7	Sept. 14	May 1	37.1
Cairo	Oct. 27	Mar. 29	Sept. 30	April 19	41.6

Indiana

Indiana is a part of that great basin called the Mississippi valley. Its extreme length, north and south, is 276 miles; extreme width, 177 miles. The surface of the state is comparatively level; the highest elevation is in Randolph county, in the center of the eastern tier of counties, and is 1,285 feet above the sea; the lowest is in the southwestern corner of the state and is 315 feet above the sea. The Ohio river bed at the southeastern corner of the state is 436 feet, and Lake Michigan at the northwestern corner is 585 feet. The northern portion of the state is quite flat with a number of small lakes, with a soil deposit of glacial formation, swamps, prairies, and in some parts heavy timber. The southern portion is hilly and bluffy along the streams. The hills are not high and generally back of the bluffs there are level plateaus. The drainage system in the southern part is toward the Ohio river; in the western part it is toward the Wabash river, and in the northern part toward Lakes Erie and Michigan, except a small portion in the northwestern part which drains into Illinois.

The oldest geological formation is the Hudson and Trenton limestone, of the Silurian age, in the southeast. West of this is the Niagara formation extending across the state, and further west is the Hamilton limestones and sandstones of the Devonian age. The soil for the most part is fertile. Originally the southern portion, as far north as the town of Wabash, was covered with very heavy forests, mostly of hardwood. North of this were prairies interspersed with sand ridges and dotted with hundreds of small lakes. This region is very productive of melons, cucumbers, certain classes of vegetables, and small fruits, and from this section a large amount of vegetable products is shipped to Chicago and other cities of the North. The richest lands are alluvial flats along the streams and where heavy vegetation has rotted on the surface. In the northwest the temperature is modified by Lake Michigan, so that it is often milder in winter in the lake region than 75 miles further south.

In the northeast the climate and soil are well adapted to the growing of apples, pears, plums and cherries of the hardier varieties, but this region is a little too cold to risk commercial orchards of peaches, pears, apricots and the tenderer varieties of cherries and other fruits. The soil is a sandy loam with a clay subsoil

originally covered with oak, hickory, walnut, maple and most kinds of hardwood.

In the southern portion of the state the soil, the climate and the contour of the land are adapted to the growing of fruits. The soil is for the most part a whitish clay that shades off in places to a dark red color. These soils are rich in lime, iron and other constituents that are adapted to fruits. The climate is, on the average, 10 per cent warmer than in the northern portion of the state. This protects the tenderer fruits from injuries by winter freezes. The land surface is uneven, and this gives a sufficient air drainage so that fruits are protected from frosts in early spring. There are apple orchards in the eastern part of this section ranging from 40,000 to 50,000 trees. The largest pear orchard is in Washington county, 12,000 trees. Peaches and other fruits of the tenderer varieties are grown in abundance, and commercially this portion of the state produces considerable wealth in fruit.

According to the census of 1910 the total number of bearing fruit trees in Indiana was 10,050,759. Of these there were: Apples, 5,764,821; peaches and nectarines, 2,130,298; pears, 708,723; plums and prunes, 566,988; cherries, 815,742; quinces, 56,847; grapes, 1,049,232 vines; nuts, 19,179 trees; small fruits, 5,919 acres. The counties producing the largest number of bearing trees are Harrison, 194,321, and Washington, 112,000.

GRANVILLE LOWTHER

Frost and Precipitation in Indiana

Station	Frost				Precipitation
	Average Date of		Date of		Annual inches
	First Killing in Autumn	Last in Spring	First in Autumn	Last in Spring	
South Bend	Oct. 8	May 10	Sept. 20	May 31	34.5
Angola	Oct. 14	April 27	Sept. 21	May 21	38.7
Lafayette	Sept. 29	April 26	Sept. 14	May 29	37.9
Marion	Oct. 2	April 24	Sept. 14	May 22	37.0
Farm Land	Oct. 14	April 21	Sept. 26	May 21	38.5
Rockville	Oct. 8	April 22	Sept. 13	May 15	37.8
Indianapolis	Oct. 19	April 16	Sept. 21	May 21	41.9
Connersville	Oct. 3	April 27	Sept. 14	May 21	38.2
Bevay	Oct. 24	April 19	Sept. 27	May 15	43.1
Princeton	Oct. 21	April 12	Sept. 30	May 14	39.4
Marengo	Oct. 10	April 10	Sept. 24	May 4	57.6

The Annual Loss Caused by Insects in the United States

Orchards and small fruits suffer heavily from insect pests. The methods of treatment necessary to prevent these losses are expensive. There are several hundred insects which feed upon the roots, trunks, foliage and fruit of the trees. Among those which feed upon the apple are the woolly aphis, San Jose scale, codling moth, tent caterpillars, etc. It is a very difficult matter to estimate the amount of loss chargeable to these insects. It is known that whatever affects the vigor of the tree itself will lessen the productiveness. It is, therefore, necessary not only to keep the tree in vigorous and healthful condition, but to destroy the insects that feed upon it. Mr. C. D. Simpson, special field agent of the Bureau of Entomology of the United States, gave some recent estimates of losses in the several states as follows:

Product	Value	Percentage of loss	Amount of loss
Cereals	$2,000,000,000	10	$200,000,000
Hay	530,000,000	10	53,000,000
Cotton	600,000,000	10	60,000,000
Tobacco	53,000,000	10	5,300,000
Truck Crops	265,000,000	20	53,000,000
Sugars	50,000,000	10	5,000,000
Fruits	130,000,000	20	27,000,000
Farm Forests	110,000,000	10	11,000,000
Miscellaneous Crops	58,000,000	10	5,800,000
Animal Products	1,750,000,000	..	175,000,000
Total	$5,551,000,000	..	$595,100,000
Natural Forests and Forest Products	....	..	100,000,000
Produce in Storage	....	..	100,000,000
Grand Total	....	..	$795,100,000

In 1889 Professor Forbes reached the conclusion that the annual loss to crops in the state of Illinois was $2,375,000. It is estimated that in 1892 insects caused a loss of $2,000,000 to the apple crop of Nebraska. Professor Sligerland estimates that in 1897 the insect taxed the apple growers of New York $2,500,000. In 1900 one-half of the crop of Idaho was damaged, while in 1901, the loss was even greater than that. Mr. McPherson estimates that in Idaho the loss in 1902 was $250,000. In many sections of the Pacific Northwest the loss in that year was from 50 per cent to 75 per cent. The American Agriculturist estimates that the average apple crop for the five years from 1898 to 1902 was 47,000,000 barrels. This includes apples of first and second quality.

It has been shown by careful observations in various apple-bearing states that the codling moth may cause a loss of from 20 per cent to 40 per cent of the fruit which would otherwise be sound and marketable. In computing the actual monetary loss to the apple growers of this country by the codling moth, we prefer to take the lower estimate rather than the higher. This 20 per cent decrease in merchantable apples would represent some 12,000,000 barrels, and at an average profit of $1.00 per barrel indicates a loss of $12,000,000, less the value of this fruit for cider, vinegar or some other use which brings in small returns. The average price for cider apples will not exceed 30 cents per barrel, which would represent a reduction of $3,600,000, leaving a net loss of $8,400,000. The loss throughout the country in small orchards, supplying local needs, undoubtedly averages much higher than in the large commercial orchards which supply the bulk of the fruit of the markets. The estimate made by Mr. Simpson of the loss in such home orchards is $3,000,000, which added to our former figures gives a total direct loss to the apple crop annually from the codling moth of $11,400,000.

One would be perfectly justified in estimating the actual loss in merchantable apples at a much higher figure than 20 per cent, and an average might be assigned of 35 per cent to 40 per cent, which would have very greatly increased the apparent monetary loss. The apple is a perishable fruit and must be consumed within a limited period. It is not like wheat and other cereals the standard grades of which have fairly fixed values and which may be kept indefinitely. The cold storage system has very much extended the marketing period of apples, but the attack by insects greatly reduces the amount of fruit of actual cold storage capacity, and the bulk of the crop must find an immediate market. Therefore, if the additional fruit which is now rendered unsalable by the codling moth should be thrown on the market, the actual price of apples would probably be affected even more than the increased supply would indicate. The increase in our export apple trade, which is being actively encouraged by the Department of Agriculture, and the development of cold storage facilities for fruit, will undoubtedly increase the market for apples from year to year. Nevertheless, one is warranted in taking the lower estimate considered above in view of the probable

decrease in price which would result if the codling moth damage did not materially reduce the crop every year.

The census of 1900 placed the number of apple trees in the United States at 200,000,000. On the authority of Mr. Taylor 165,000,000 of these were in bearing condition and the cost of spraying and other treatment for these will range between 5 cents and 10 cents per tree. As an offset to untreated orchards the lower estimate of costs may be taken, namely, 5 cents, which gives a charge for treatment of $8,250,000. Combining the direct shrinkage or loss and the cost of protection from still greater loss, gives a total tax, chargeable to the codling moth, of nearly $20,000,000. The insect losses to other deciduous fruits are quite as heavy as in the case of the apple, and especially when the treatment for the San Jose scale and other pests are considered, and in the case of citrus fruits the cost of treatment is much greater and the actual losses are again heavy. We are warranted, therefore, in placing the loss to fruits from insect pests as high as 20 per cent annually.

GRANVILLE LOWTHER

INSECT ENEMIES. See *Beneficial Insects, Propagating and Distributing.*

Insecticides

How Contact Insecticides Kill

It has long been known that certain substances when brought in contact with the outer surfaces of insects will produce death. Why they kill has not been so well understood. In order to answer this question Geo. D. Shafer, of the division of entomology of the University of Michigan, undertook a series of elaborate experiments with results as recorded below.

The insecticides experimented with were gasoline, kerosene, benzol, xylene, turpentine, creosote, aniline oil, carbon disulphide, chloroform, ether, pyro cresol, special kreso-dip, creolin, chloronaphtholium, crel oil, zenolium, to-bak-ine, pyrethrum, hydrocyanic acid gas, carbon dioxide, nitrogen and hydrogen.

By "contact insecticide" is meant any substance which kills by contact rather than by being eaten, and the definition is made to include gases and powders as well as the liquid sprays.

The first part of the experiment was undertaken to ascertain if the various miscible oils such as kerosene and gasoline plugged the breathing apparatus of the insect and so produced death by suffocation. It was found that the plugging actually took place, but that suffocation was not the cause of death; for it was discovered that grasshoppers, beetles, caterpillars and other insects would regain their activities after having lain in the water for several hours apparently dead or in a closed vessel containing carbondioxide with all oxygen excluded. But these same insects when subjected to treatment with an insecticide would lose all motion in a few minutes and never thereafter recover. It was therefore concluded that death was the result of some other cause than mere suffocation. In fact numerous experiments extending back as far as 1670 show that insects succumb from suffocation with difficulty. Besides, an oil was found that as effectually plugged the trachea of insects as the oils mentioned, but that when removed from it they gradually recovered.

Experiments were then made which showed that insects would die under the influence of the vapor of gasoline as readily as if dipped in the liquid itself, showing that death was the result of some influence of the gasoline rather than suffocation.

Tests were next made to ascertain if the substances used actually passed into the tissues of the insect body. This was found to be true, but the absorption took place in many cases only after considerable time had elapsed, in some cases long after death had taken place.

Careful observations were then made to detect the effect upon heart action and respiration. In many cases, though not all, heart action was greatly increased, sometimes to the point where it was no longer possible to count the beats, then they would suddenly fall below normal. Respiration was irregular also.

The next part of the experiment was a series of very careful measurements to determine the freedom of absorption of oxygen, which is essential to the life of the insect while under the influence of the insecticide. This part of the experiment led to the conclusion that it is the prevention of the proper absorption of oxygen into the body tissues of the insect that renders the kerosene, gasoline, carbon disulphide and similar insecticide so poisonous.

"Lime-sulphur is a special rather than a general contact insecticide." Its strong persistent ability to take up large amounts of oxygen and "its ability to soften the wax about the margin of the scale insect like the San Jose scale are the important properties that make it efficient as a scalecide."

Reference

Michigan Agricultural College Experiment Station, Bulletin 11; Geo. D. Shafer.

INSECTICIDES. See *Sprays*.

Iowa

Iowa is 310 miles east and west and 210 miles north and south. It is part of the great Mississippi basin and is mostly an undulating prairie, rising in swells or small ridges like the waves of the sea in the ordinary calm. Beginning with the Mississippi river these elevations rise gradually higher and higher to a divide running diagonally from a height of 1,694 feet in the northwest to a slight elevation in the southeast. There are now no swamps, although in early times the state was largely covered with swamps. There are few natural forests, although in the northwest there is a considerable area that was at one time covered with trees. There are skirts of timber along the streams. Two-thirds of the state is drained by streams leading to the Mississippi river. The western drainage is toward the Missouri river. The northern part has a number of small lakes similar to those of Minnesota, formed by the same action or system of glacial deposits, some of them surrounded by a natural wall of loose stones, the water pure and clear.

The climate is a little severe, the mercury occasionally dropping to 40 degrees below zero. The average rainfall is about 31 inches. No less than five separate sheets of drift cover the state, giving a variety of productive soils.

Iowa is not so well adapted to fruit-growing as are some of the states further south. Some of the very hardy varieties may be grown successfully, but it lies in a latitude where the mercury occasionally drops to 40 degrees below zero, while the climate is not modified by ocean or lake breezes, and there are no sections sheltered by high elevations or mountain ranges. However, hardy varieties of apples, sour cherries, currants, gooseberries, strawberries, raspberries and blackberries are successfully grown for home use in all parts of the state. Commercial orcharding is not extensively conducted.

The drainage systems for Iowa are the Mississippi and Missouri rivers with their tributaries. The principal fruit-growing sections are counties bordering on the Missouri river and on the Des Moines, which drains into the Mississippi.

The principal apple producing counties near the Missouri river are: Fremont, 159,959 bearing trees; Harrison, 130,898; Mills, 242,466; Page, 145,895; Potawatamie, 259,113; Taylor, 112,585. The counties on the Des Moines river producing the largest number of trees are: Mahaska, 110,203; Polk, 145,895; Warren, 114,-158.

The total number of bearing apple trees in the state is estimated at 5,847,-034; the total number of peaches and nectarines, 1,090,749; plums and prunes, 1,155,041; cherries, 908,764; grapes, 1,983,465; strawberries, 2,917 acres; raspberries and loganberries, 1,573 acres; blackberries and dewberries, 2,279 acres; nuts, 163,337 trees.

GRANVILLE LOWTHER

Apples Recommended for Commercial Planting in Northern Iowa

Oldenburg *(Duchess)*, Patten *(Patten Greening)*, Wealthy, Northwestern *(Greening)*, Salome (Trial), Colorado Orange (Trial).

For Home Use

Lowland *(Lievland Raspberry)*, Oldenburg *(Duchess)*, Charlamoff, Patten *(Patten Greening)*, Wealthy, Eastman, Longfield, Northwestern, Delicious (Trial), Salome, Black Annette (Trial), Windsor, Tolman Sweet, Allen Choice, Colorado Orange.

Apples Recommended for Commercial Planting in Southern Iowa

Grimes Golden, Jonathan, Delicious (Trial), Stayman *(Stayman Winesap)*, Gano, Black Ben Davis and Ben Davis, York Imperial (Trial).

For Home Use

Red June, Oldenburg *(Duchess)*, Benoni, Chenango, Dyer, Wealthy, Fameuse *(Snow)*, Roman Stem, Bailey Sweet, Grimes Golden, Jonathan, Salome, Delicious, Tolman Sweet, Stayman *(Stayman Winesap)*, Winesap, Ralls *(Genet)*, Gano, Black Ben Davis, Ben Davis, York Imperial.

The following fruits are suggested as standard varieties for Iowa:

Apples

Duchess of Oldenburg, Wealthy for northern drift, Jonathan for southern loess.

Crabs

Hyslop, Florence, Martha, Virginia.

Plums

De Soto, Wyant, Miner.

Cherries

Early Richmond, Montmorency.

Grapes

Moore's Early, Worden, Concord.

Raspberries

Older, Kansas.

Blackberries

Snyder, Ancient Briton.

Currants

Victoria, Red Dutch, White Grape.

Gooseberries

Downing.

Strawberries

Dunlap, Warfield.

While none of the varieties mentioned are perfect, they have proven the most satisfactory out of all the varieties tested and can be safely used as a standard for comparing other varieties.

Apples

For Northern Drift: Patten's Greening, Longfield, Charlamoff, Salome, Malinda, Northwestern Greening. Sweet apples—Tolman.

For Southern Loess: Benoni, Maiden's Blush, Fameuse, Grimes Golden, Winesap, Stayman, Genet, Roman Stem, Gano. Sweet apples—Sweet June, Ramsdell's Sweet, Paradise Winter Sweet. For dessert use—Early Joe, Fall Wine, Chenango, Dyer, Rambo.

Pears

Kieffer, Seckel, Flemish Beauty, Bartlett.

Peaches

For Southern Loess: Champion, Crosby, Elberta, Triumph.

Grapes

For Southern Loess: Diamond, Niagara, Agawam, Brighton.

Raspberries

For Southern Loess: Cuthbert, Turner, Cumberland, Columbian.

Dewberries

Lucretia.

The above lists are suggested by the Iowa State Horticultural Society.

The state society does not recommend a list of fruits for planting in any district; it recognizes the fact that each grower can select varieties better adapted to his locality than anyone else. The list given is to assist those who have not given much study to varieties. Where no locality is mentioned the varieties named are for general planting on all soils. The northern part of the state is mostly covered with drift and the southern part with loess. The soil, rainfall and elevation changes the temperature so that the thermal zones do not correspond with degrees of latitude. As an example: Budded peaches seldom prove profitable when planted north of the line showing a mean annual temperature of 49 degrees, though they may be grown much farther north.

For additional information on orchard sites and soils, see *Selection of Site* under *Apple Orchard*.

Frost and Precipitation in Iowa

Station	Frost				Precipitation
	Average Date of		Date of		
	First Killing in Autumn	Last in Spring	First in Autumn	Last in Spring	Annual inches
Charles City	Sept. 5	May 3	Sept. 12	May 21	29.8
Larrabee	Sept. 20	May 11	Sept. 12	May 31	30.4
Alta	Sept. 26	May 7	Sept. 12	May 30	30.7
Hampton	Oct. 2	May 4	Sept. 20	May 31	33.2
Fayette	Sept. 18	May 8	Sept. 11	May 31	32.7
Elkader	Sept. 23	May 5	Sept. 11	June 1	31.2
Sioux City	Sept. 23	May 1	Sept. 13	May 21	25.5
Sac City	Sept. 22	April 30	Sept. 12	May 19	31.1
Iowa Falls	Sept. 22	May 7	Sept. 12	May 31	29.8
Grundy Center	Sept. 26	May 3	Sept. 12	May 31	34.0
Independence	Sept. 26	May 4	Sept. 12	May 31	27.4
Dubuque	Oct. 12	April 20	Sept. 27	May 21	35.0
Carroll	Sept. 22	May 5	Sept. 12	May 31	32.4
Newton	Oct. 8	April 26	Sept. 20	May 19	33.6
Belle Plaine	Oct. 4	May 1	Sept. 20	May 31	34.5
Amana	Oct. 5	April 23	Sept. 20	May 14	31.2
Cedar Rapids	Oct. 8	April 19	Sept. 20	May 14	37.1
Iowa City	Oct. 8	April 23	Sept. 20	May 14	32.3
Clinton	Oct. 2	April 28	Sept. 13	May 26	32.9
Davenport	Oct. 13	April 22	Sept. 18	May 22	32.9
Atlantic	Sept. 19	May 11	Sept. 2	May 31	32.4
Greenfield	Oct. 9	April 29	Sept. 18	May 21	31.7
Des Moines	Oct. 8	April 28	Sept. 12	May 22	32.4
Washington	Oct. 7	April 23	Sept. 13	May 14	28.7
Corning	Oct. 2	April 26	Sept. 12	May 19	31.3
Clarinda	Oct. 6	April 19	Sept. 13	May 3	33.1
Corydon	Oct. 5	April 28	Sept. 18	May 19	35.3
Bonaparte	Oct. 7	April 20	Sept. 20	May 14	33.3
Keokuk	Oct. 22	April 11	Sept. 18	May 2	35.1

Irrigation

History of Irrigation

Irrigation is the process of watering land by ditches or other artificial means.

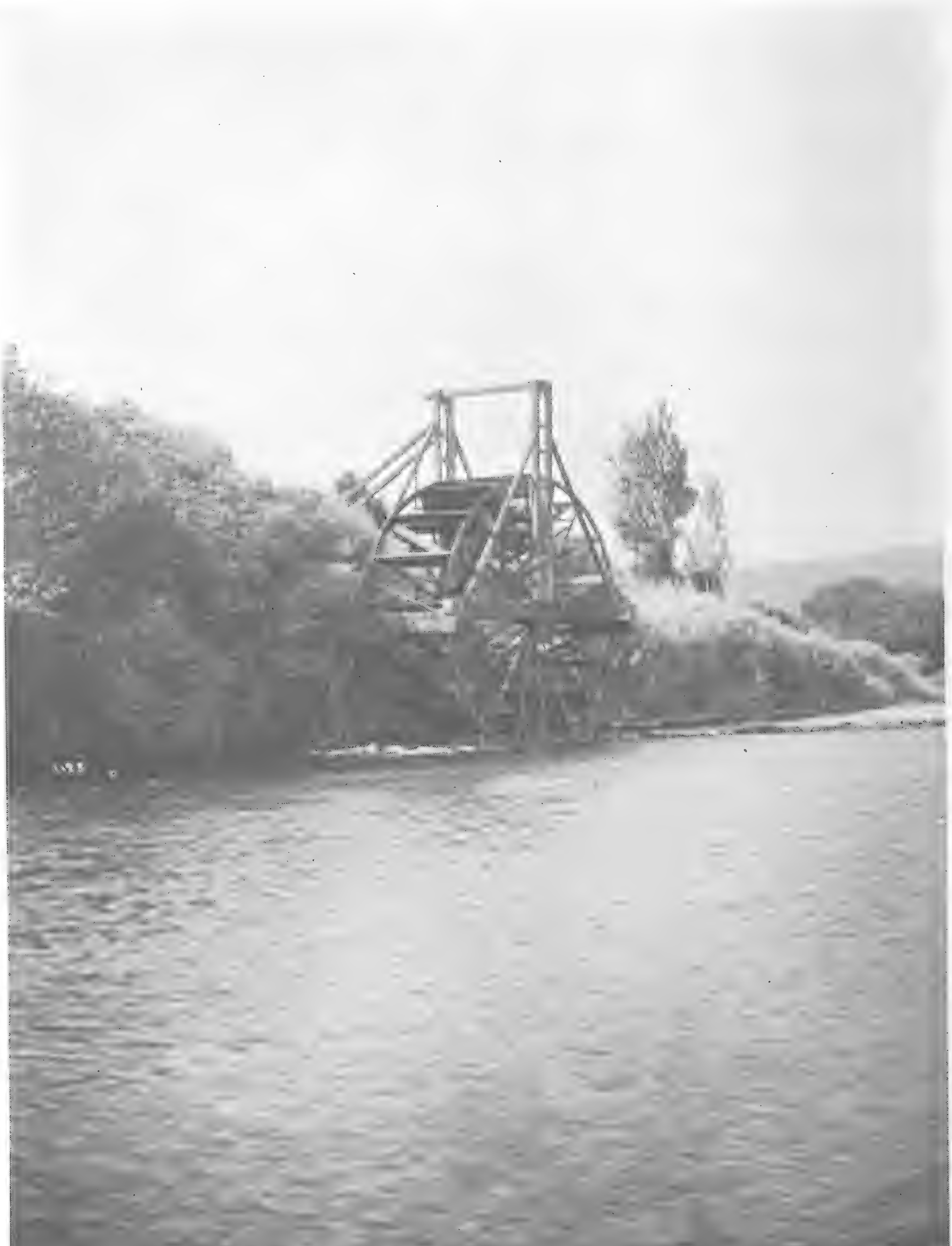
It is generally employed where the rainfall is insufficient for the growing crops, or where it comes at unseasonable times. The sources of supply are snows in the mountains, glaciers, lakes, rivers, springs, underground waters obtained by means of pumps, artesian wells, etc.

Ancient Irrigation

In ancient times the inhabitants of Egypt along the Nile, and of Babylonia along the Euphrates irrigated their lands by means of crude systems for lifting water from wells, rivers and ditches.

Professor James H. Breasted, of Chicago University, a noted Egyptian archaeologist, says: "The date of the earliest irrigation in Egypt is not less than 3500 B. C. It is impossible to say how much earlier, perhaps several centuries—may be five or six, or even eight."

Professor D. D. Luckenbil, Babylonian archaeologist, writes: "The earliest reference to the digging of canals for irrigation occurs in the inscriptions of Urnina of Lagash, who lived about 3000 B. C. It is evident from inscriptions which date from later times, but mention events whose occurrence must be placed before the date of Urnina, that irrigation was known to the inhabitants of the Tigris and Euphrates valleys centuries



Old Waterwheel at Benton City, Washington.

—*Colville Photo*

before 3000 B. C. About 3500 B. C. would certainly be conservative. There is an ancient document called the 'Laws of Hammurabi' which contains a section on irrigation, and reads as follows:

"'If any one is too lazy to keep his dikes in order and fails to do so, and if a breach is made in his dike and fields are flooded with water, the man in whose dike the breach was opened shall replace the grain which he has destroyed. If he is not able to replace the grain, he and his property shall be sold and the people whose grain the water carried off shall share the proceeds.'

"If any one opens his irrigating canals to let in water, but is careless and the water floods the field of his neighbor, he shall measure out grain to the latter in proportion to the yield of the neighboring field." This document dates from 2340 B. C., and indicates that irrigation was under the control of the government at that date.

Sargon left a tablet about 3800 B. C. which relates to the story of his boyhood as follows: "I am Sargon the mighty king. My mother, of noble race, conc ived me and bore me in secret. She put me in a basket of Sur and closed up the openings with bitumen. She cast me into the river. The river carried me along to Akki, the irrigator. Akki, the irrigator, took me up. Akki, the irrigator, reared me up to boyhood. Akki, the irrigator, made me a gardener." (McCurdy, History-Prophecy and the Monuments.)

It was doubtless the system of irrigation in use in Babylonia to which the plaintive song of the Hebrews referred when they said: "By the rivers (irrigating ditches) of Babylon, there we sat down, yea we wept when we remembered Zion."

Early Irrigation in America

Irrigation was practiced in prehistoric times by the town-building Pueblo Indian tribes inhabiting portions of New Mexico and Arizona. The descendants of these tribes still utilize some of the lands which were tilled by irrigation at the time when the Spaniards first came from the south and practiced many of the primitive customs of their ancestors The early missionaries of the Pacific coast also used the same customs (learned from these Indians), and in Southern California particularly are to be found the ruins of substantial dams and headworks built by Indian labor. The Mexicans, of mixed Spanish and Indian origin, gradually extending their settlements from the south, through necessity practiced irrigation. There are said to be ditches in Arizona and New Mexico, one of which is buried 50 feet beneath the present surface of the soil.

The Mormons Irrigate

The first irrigation practiced in the United States by English-speaking people was by the Mormons near Salt Lake, in Utah. Brigham Young, their leader, was a man of vision, imagination and great ability. Whether from necessity, or from inventive genius, he succeeded in turning the waters of the little canyons and streams onto the parched desert and after a few years mastered the art of modern irrigation.

Cary Act Projects

The early settlers in the arid regions irrigated their land by means of small ditches which could be constructed at little expense. When it became necessary to reclaim larger areas of desert the expense became too great for small co-operative enterprises and for the relief of this condition the "Carey Act" was passed by congress, which "provides that the federal government will grant, without charge, to each of the states containing desert lands 1,000,000 acres, or as much thereof as the state shall cause to be reclaimed, provided that such states shall bind themselves to dispose of the same in tracts of not to exceed 160 acres to actual settlers." Under this act the state does not reclaim the land, but avails itself of the benefit of the law by means of contracts made with construction companies. "At the request of the state the federal government segregates the tracts desired. The state then makes a contract with some company to construct the necessary reservoirs and canals." When the work is completed the land is patented

to the state, and in turn patented to the settler when he has complied with the provisions of the law. The construction company is paid a fixed sum for the water, the enterprise is under the supervision of the state authorities and the water users have charge of the canals for maintenance.

What Carey Act Lands Are and How Title Is Obtained Thereto

Under the operations of this act the federal government turns over to the states such land as they may desire to procure for reclamation from time to time.

When this land is turned over to the state for reclamation it enters into a contract with some company to construct an irrigation system and sell water rights therein to the settlers at a price fixed by the state contract and upon the terms therein specified. Upon the making of a contract the irrigation company proceeds to construct the irrigation system under the general supervision of the state engineer and subject to his approval and direction from time to time. When the construction of the system is advanced to such a state that water can be delivered or will shortly be delivered the state opens the lands to settlement, selling the land at fifty cents per acre to all entrymen who purchase water rights of the irrigation company at the price fixed in the state contract. Thus it will be seen that the enterprise from its inception to the final turning over of the system is subject to state inspection and supervision—with a consequent assurance not only as to the feasibility of the original undertaking, but also as to the method by which the irrigation system is constructed and finally completed.

The procuring of title to these lands is simple and comparatively inexpensive and is free from the difficulties and long-residence requirements of the homestead and government reclamation laws.

Only thirty days' residence is required before final proofs may be made. As soon as an entry is made, the entryman can, if he wishes, at once begin the improvement of his land by doing his clearing, plowing, etc., and if, when water is ready for delivery, he has one-eighth of his holding under cultivation (that is, seeded and ready for irrigation), and then begins actually irrigating that one-eighth, he may at once give notice of intention to make final proof, by publication in a newspaper published in the county in which the land is situated for four weeks immediately preceding the date set for making final proof, during all of which time he must reside on the land, and if married, he must establish his home with his family. In this way, title can be secured with only about thirty days' residence.

It will be seen from the foregoing that the term of residence and the length of time required for proving up is largely optional with the settler. He may put one-eighth of his land under cultivation and have it ready for irrigation as soon as water is delivered. He may then turn the water onto this one-eighth and immediately begin publishing his four weeks' notice of intention to prove up and at the expiration of that period may make final proof, thus making his final proofs in about thirty days. On the contrary, if he does not care to make his final proofs at once, he may continue cultivation and residence and not prove up until the end of the three years' period allowed by the statute. Of course, the great advantage of proving up in the shortest possible period is that it relieves one of the necessity of continued residence on the land and enables him to perfect his title immediately.

Questions Answered Regarding the Carey Act

Land and water rights under the Carey act are assignable both before and after proof.

Married women can not file on lands under the Carey act, but widows may.

One person may file for another under power of attorney.

It is not necessary to visit the land before filing.

Within one year after notification that water is ready for delivery the settler must cultivate one-sixteenth of the entry;

he must then cultivate an additional one-sixteenth the second year, and the third year final proof must be made showing one-eighth of the land under cultivation. This is the *maximum* time allowed the settlers. He may, as already stated, do all his cultivating and complete his proofs in about thirty days.

The Carey act, under which these lands are entered, should not be confounded with the United States reclamation act or with the homestead laws. Under the reclamation act the settler is required to conform to the homestead laws of the United States; to pay the cost of his water right, and to actually reside upon the land for five (5) years. None of these requirements apply to Carey-act lands. The homestead commutation clause does not apply to lands taken under the reclamation act.

Under the Carey act the settler pays the state 50 cents per acre for the land in two equal instalments, contracts with the irrigation company for a water right for the land at the price per acre fixed by the State Land Board, and after residing upon the land for about thirty days, and putting one-eighth of it in cultivation and under irrigation, may make final proof and entitle himself to receive his patent for the same.

After the irrigation system is completed and approved by the state authorities, it is turned over to the settlers for operation. They thereafter own and operate it for their own benefit and are thus relieved of paying any profit on operation to anyone. This is accomplished by the organization of a settlers' operating company, the shares of which are transferred to the settlers on a basis of one share for each acre. This stock is issued to the settlers at the time they make their entries and execute their water contracts, no additional charge therefor being made.

After final proof the settler can mortgage the land and water right, subject to the lien for deferred payments on his water right. This is a great advantage to the settler of moderate means, as he can thus obtain any additional money which he may require to cultivate his land, make improvements, buy machinery, etc., and thus he avoids the disadvantages of the long period of residence required under the reclamation act, during which time he has no title to the land, and no right to mortgage it to secure money for making improvements.

RECLAMATION BY THE UNITED STATES GOVERNMENT

Reclamation Act

The reclamation act was made a law by the signature of President Roosevelt on June 17, 1902.

This act provides that all moneys received from the sale and disposal of public lands in Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, Oregon, Nevada, South Dakota, Utah, Washington and Wyoming, beginning with the fiscal year ending June 30, 1901, including the surplus of fees and commissions in excess of allowances to registers and receivers, and excepting 5 per cent of these amounts, which is set aside for educational and other purposes, shall be set aside and appropriated as a special fund in the treasury of the United States, to be known as the "reclamation fund," to be used in the examination and survey for, and the construction and maintenance of, irrigation works for the storage, diversion and development of waters for the reclamation of arid and semi-arid lands in the said states and territories.

The lands so reclaimed are subject to homestead entry, and there is absolutely no charge for the land itself, but the settler must pay to the United States, in not more than ten annual instalments, without interest, his proportion according to the number of acres he owns, of the amount expended by the United States in reclaiming his land. The collection of operation and maintenance charges is not definitely provided for in the reclamation act; however, the authority of the Secretary of the Interior to collect such charges has been upheld by the decision rendered in the Baker-Swigart suit, which was in effect a test case on this point.

Amendments

The amendments to the reclamation act have been relatively simple; most of them relate to work on the Indian reservations, or to interstate or even international complications. Probably the most important is that of June 25, 1910, relating to advances to the reclamation fund. Under this amendment an advance or appropriation of $20,000,000 was made, to complete the reclamation projects and such extensions as may be deemed necessary for the successful operation of the works, also to protect water rights claimed by the United States. Another and very necessary provision of this act of June 25, 1910, was the repeal of section 9 of the original reclamation act, which, by attempting to limit expenditures, largely by state lines, tended to lack of economy, and forced a construction of works where the need was not wholly established.

Purpose

The purpose of the reclamation act is to provide for the reclamation by irrigation of arid lands, the motive being one which is fundamental to the growth and maintenance of a democratic form of government. It gives opportunities for citizens to obtain homes on small farms where they may support their families. Under good irrigation it is possible to practice intensive agriculture to the highest degree, and thus produce the most valuable crops.

Establishment of the Reclamation Service

Immediately after the reclamation act was approved, the Secretary of the Interior was advised by the Director of the Geological Survey regarding the investigations which had already been made by the Geological Survey as to the extent to which the arid region could be reclaimed.

During many years preceding the passage of the reclamation act the Geological Survey had been preparing topographic maps showing the possibilities of many streams that could be used in irrigation, and their catchment areas. Thus, when the reclamation act became a law, there were already employed in investigation a considerable number of men experienced in such work.

Under authority from the secretary, these men were organized on July 2, 1902, into the sub-bureau known as Reclamation Service, under the Geological Survey. This organization was so continued until March of 1907, when the service was separated from the survey and made a separate bureau under the Department of the Interior.

Indian Irrigation

Under an agreement made in 1907, between the office of Indian Affairs and the Reclamation Service, certain irrigation work on Indian reservations, authorized by Congress and provided for in appropriations under the control of the Indian office, is being performed by the Reclamation Service. The cost of such work is returned to the reclamation fund from authorized Indian appropriations upon statements rendered monthly.

Work Accomplished Under the Reclamation Act

A summary prepared by the Reclamation Service shows results to June, 1913, in connection with the twenty-eight different projects upon which operations have been carried on by the service in the various states enumerated above, as follows:

Present plans contemplate the ultimate irrigation of 3,000,000 acres. Of this acreage, water was available for 1,300,000 acres. Some 27,000 farms are included in this area.

The service had at this time something over 5,000,000 acre-feet of reservoir capacity available by the construction of numerous storage dams. Eight thousand miles of canals and ditches had been constructed.

Investment

The total net investment of the Reclamation Service to June 30, 1913, amounted to $77,231,555.24.

UNIT OF MEASUREMENT

The standard measurement for water in many sections of the country is known

as the "miner's inch." This method came from the custom followed by miners in appropriating water for the separation of gold from the sands and gravel. The "miner's inch" as a unit of measurement was well adapted to the mining industry, but it seems not well adapted to the conditions of agriculture. The "acre-foot," or fraction thereof, as a unit of measurement is better than the miner's inch, because it conveys an idea of a certain depth of water over a certain area of land, as an acre. Almost every one is familiar with the expressions indicating inches in depth. For instance, it is known that in the Yakima valley there is on the average six inches of precipitation per annum, and that this classifies the land as arid. They know, too, that 15 to 20 inches classifies land as semi-arid, and that 30 to 40 inches is sufficient for the growing of corn and general farming, but no one, unless he has had special education in hydraulics, knows the relations of a miner's inch to any depth of water covering an acre of land.

The United States Government makes its reports of precipitation in terms of inches. It also estimates the water delivered to the irrigators under its projects in the same way.

Different canal companies use different units of measurement, so that it is difficult to express these units in the terms of acre-feet, or the miner's inch. For instance, in the Yakima valley, Washington, are the following ditches with the following units of measurement: Naches and Cowichie Ditch, one miner's inch per acre; Yakima Valley Canal Co., one inch per acre, measured over a wier. The Selah Ditch Co. gives two-fifths inches per acre, measured under six inches of pressure. The Terrace Heights Company gives one-third of an inch per acre, measured through a meter. The Tieton, a government project, gives two and seventeen-one-hundredths acre-feet. The Moxee Canal Co. gives one cubic foot per second for 160 acres of land. The Washington Irrigation Company one cubic foot per second for 160 acres. The Fowler Ditch Co. one cubic foot per second for 150 acres.

The difficulty is for the average person to know what relations these different standards sustain to each other, or to the standard adopted by the government.

The miner's inch is not a uniform unit for all states. The court of Kittitas county, Washington, has defined the miner's inch as "the amount of water which will constantly flow through an opening one inch square through a plank one inch thick in the side of a box in which still water is maintained at a constant depth of four inches above the top of the opening."—*Engineering News*, Nov. 7, 1907.

In California the measurement is taken from center of the opening instead of the top.

Generally throughout the Yakima valley a miner's inch is defined as the flow of water through an inch aperture under six inches of pressure. In some cases the aperture is made two inches wide and one-half inch long instead of one inch square, and this gives less water than the inch square because there is more friction surface. A continuous flow of one miner's inch is commonly supposed to be enough to irrigate two acres. However, this depends on the character of the soil and the character of the crop grown.

It is necessary to distinguish between the terms "miner's inch," "cubic inch" and "acre inch," as it is to distinguish between the terms "second foot," "cubic foot" and "acre foot."

The cubic foot is a cube of one foot on every side and contains 1,728 cubic inches. It also contains seven and one-half gallons.

The acre-foot is one foot deep over one acre of land.

The second-foot is a cubic foot of water discharging from a certain point in one second of time.

The "acre-foot" is a measurement of volume, while the term "second-foot" is a statement of the rate of flow. A continuous flow of one second-foot for 24

hours will cover one acre two feet deep, equal to two acre-feet.

Approximate Estimate of Water

It requires an engineer with proper instruments to obtain an accurate estimate of the amount of water flowing in a ditch, but an approximate estimate may be made as follows: Secure the cross section by measuring the depth in a number of places at given distances across the stream, adding them together and dividing by the number of measurements taken. This will give the average depth, which should be multiplied by the width of the stream at the surface. This will give the number of square feet in the cross-section of the stream. Then measure off on the ditch bank any distance, say 20 feet parallel with the current. Throw a stick into the center of the stream where the water is running at its greatest velocity and far enough above the first measurement so that the stick will have time to acquire the same velocity as the stream before it reaches the point of the first measurement. Take the time in seconds required for the stick to float the distance measured. This will give the velocity of the mid-current. Eighty-three per cent of this will give the average mean velocity of the whole stream. Multiplying the number of square feet in the cross-section by the velocity of the stream, in seconds, will give the number of cubic feet per second of time.

In the case of small ditches reduce all measurements to inches. On account of the filamentous or thread-like character of water there is a tendency to compression as it passes through an orifice. After the discharge it continues to converge so that the section of the water after leaving the orifice is smaller than the orifice from which it discharges. This is because the inertia of the water opposes any change in direction, and the convergence continues for a distance of about half the diameter of the orifice.

Laterals

A lateral is a ditch taken from the sides of the main ditch.

A sub-lateral is taken from the side of a lateral.

In taking water from the main channel, leading it out in different directions over the lands, many laterals and

Fig. 1. Showing Method of Conducting Water Around a Low Spot at the Corner of an Orchard.

sub-laterals and branches of sub-laterals may be necessary in order to convey water to the lands to be irrigated. When it reaches the land, it is generally discharged at the highest point to be irrigated, and from there carried in pipes, or small ditches for distribution.

The irrigation system if seen on a map would resemble somewhat a river with its tributaries reversed. The tributaries of a stream flow from the higher lands in rivulets creeks and streams into the main channel. The irrigation system flows from the main channel and branches into smaller ones as the water is conveyed to the lands to be irrigated, which lands must be lower than the intake of the canal, in order that there may be a gravity flow.

How to Conduct Water to Land

What is the best method of conducting water to the lands? It is generally conceded that while as an initial cost the open ditch system is cheaper, nevertheless in the end it is more expensive, and that there is considerable loss on account of evaporation and seepage. Just how much this loss is, depends largely upon the soil, amount of sunshine, wind, and the intensity of heat.

Measurements to Ascertain Loss

In the canals of Colorado, California, Utah, Washington and Wyoming, careful measurements have been made which indicate that the losses range from almost nothing in some of the best and most favorably situated canals, to 50 per cent in canals built in porous soils. Piping is not always practical, but where it can be used it is best, especially in those sections of the country where water is scarce. The economy which could be effected by the use of piping in the distribution systems is illustrated by the following table compiled by the pipe companies:

Canals carrying 100 cu. ft per second, or more, loss per mile	1% to 5%
Canals carrying 50 to 100 cu. ft. per second, loss per mile	3% to 8%
Canals carrying 25 to 50 cu. ft. per second, loss per mile	7% to 14%
Canals carrying 15 to 25 cu. ft. per second, loss per mile	10% to 18%
Canals carrying 5 to 15 cu. ft. per second, loss per mile	16% to 27%
Canals carrying 2 to 5 cu. ft. per second, loss per mile	20% to 40%

The preceding percentages of loss are general averages and may vary in different localities according to climatic and soil conditions; but it will be noted that the losses rise very rapidly as the volume decreases. Hence the smaller the ditch the greater the loss. The greatest economy is therefore secured in those cases where the pipe would of necessity be small, say from 4 to 12 inches in diameter. These losses are wholly preventable, and as water becomes more valuable and the cost of delivery greater, prevention will pay. On many irrigated districts the slope of the land is too great for ditches unless stop-boxes or drop-boxes are provided. In many cases lands and crops below the ditch are damaged by breaks due to washing where the slope is too great.

Capacity of Pipes

It may be interesting to note the relative carrying capacity of several typical sizes of ditches compared to those sizes of wood pipe which, on various gradients or slopes, will carry approximately the same quantity of water as the ditches given—the ditches being assumed to be built on that gradient which will not induce an excessive velocity. It should be borne in mind that much greater velocities are permissible in pipes than in ditches.

4-inch pipe:	
Slope 1 in 20, discharges 0.6 sec. ft. Slope 1 in 50, discharges 0.38 sec. ft.	Ditch requires 1.0 ft. bottom width
6-inch pipe:	
Slope 1 in 30, discharges 1.5 sec. ft. Slope 1 in 60, discharges 1.0 sec. ft.	Ditch requires 2 0 ft. bottom width
8-inch pipe:	
Slope 1 in 40, discharges 2.8 sec. ft. Slope 1 in 80, discharges 2.0 sec. ft.	Ditch requires 2.5 ft. bottom width
10-inch pipe:	
Slope 1 in 50, discharges 4.6 sec. ft Slope 1 in 100, discharges 3.2 sec. ft.	Ditch requires 3.0 ft. bottom width

12-inch pipe:	
Slope 1 in 75, discharges 6.3 sec. ft Slope 1 in 150, discharges 4.5 sec. ft.	......Ditch requires 3.5 ft. bottom width
16-inch pipe:	
Slope 1 in 100, discharges 11.7 sec. ft.	......Ditch requires 5.0 ft. bottom width
Slope 1 in 250, discharges 7.25 sec. ft.	......Ditch requires 4.0 ft. bottom width

The gradient or slope of a pipe line refers to the slope of a straight line drawn between the intake of the pipe and the center of the discharge end. This line is technically called the hydraulic grade line. The pipe may be laid at any distance below this line, but never above it.

There are many variables entering into a determination of the actual duty of water. In general terms, however, it may be said that seldom will one second-foot be required for 60 acres, more often 100 acres, and with economy where ordinary crops of wheat and corn are grown as many as 200 acres.

As heretofore suggested, the steeper the grade the greater will be the amount of water a given size of pipe will carry, and hence a small pipe on a steeper grade will often carry as much water as a comparatively large ditch which always must be built sufficiently high to discharge onto the adjacent fields. This means a loss of cultivated area, and often serious inconvenience to the irrigator. With buried pipes carrying water under pressure, these annoyances are avoided entirely, and the water may be delivered with facility upon any portion of the field. If wood pipe be used gate valves can be introduced with decided economy and convenience. In addition to this, they can always be closed when the necessary water has been applied, and thus the pipes can always be kept full, whence economy and conservation. A full pipe means a saturated pipe, and when the wood of the pipe is saturated there can be no rot. Experience has proven bebeyond doubt that rot is prevented by saturation.

Basis for Selling

It is always much more satisfactory to sell water based on a price for the actual water used, rather than to sell it on the basis of acres irrigated. The latter method invites waste on the part of the user, since it is but human nature for the irrigator to draw on the water supply up to a point where he feels satisfied he is getting all he pays for. By the other method he pays for exactly what he gets. The temptation being removed, the loss from this source is eliminated and the irrigable area correspondingly increased. In fact, some states, notably Idaho, have a law requiring all charges for water to be "based upon the quantity delivered to consumers and not in any case to depend upon the acres irrigated." With a pipe system it is easy to determine the amount of water used.

SYSTEMS OF IRRIGATION

There are several systems of irrigation, each having some merit, and perhaps each one best under certain circumstances.

Flood

The first is the system of flooding which is used in the rice fields with a degree of success that justifies its continuance. Experience seems to have proven that this system is the best for the conditions under which rice is grown, and perhaps no other system could be adopted that would be so practical for the growing of this crop.

Check

The second is the check system, which makes the ditches in squares around the trees and overflows the ground inside of the squares or causes the water to percolate through the soil in the ditches.

Furrow System

The third is the small furrow system, which makes small laterals about three feet apart and allows the water to run from the main lateral on the high point of the land in small streams. From these small ditches the water percolates through the soil until the whole surface soil is wet. It is presumed that when the surface shows that the water has percolated until the dampness from each stream meets in the center one and one-

Fig. 1. Furrow Method of Irrigation.
—*Colville Photo*

half feet from the ditch that it has percolated also to a depth which is equivalent to its lateral percolation. Then it is turned onto another portion of the field or orchard and as soon as the irrigated portions are dry enough they are cultivated while the water is still running, and thus irrigation and cultivation in different parts of the orchard are being carried on at the same time.

Underground Method

Another method is underground ditches into which the water is run and allowed to saturate the soil at greater depth than is possible with surface irrigation.

The most popular method at present for most conditions is the small furrow method of surface irrigation, although it is conceded that the underground method has many things to commend it, and seems to be ideal when the conditions of soil are right for its application. Among the things urged in favor of underground irrigation are the following:

First: Economy of water, because there is less evaporation by this method than where water is placed on the surface.

Second: Economy in time, since there is not the trouble of making surface ditches five times a year or as many times as the land is irrigated, and no time is wasted in waiting for the ground to dry for cultivation. The amount of water taken up by the surface soil under force of capillary attraction is not

Fig. 2. Check-Furrow System. Two Longitudinal Furrows are Connected by Four Cross Rills for Each Tree. By putting check dams in the main furrows water can be held around the tree until taken up by the soil.

sufficient to make the ground too wet for cultivation.

Third: Placing the water below the surface, at a depth of from 1 to 3 feet, causes the roots to penetrate more deeply, to break up a new substratum of soil from which they extract food which is equivalent to extending over a much wider lateral surface, and therefore increasing the life of the tree besides increasing its rapidity of growth and bearing capacity.

Fourth: In case of sub-irrigation from other lands this underground system is a drainage system as well as an irrigating system.

Fifth: It tends to aerate the soil, for a certain amount of air passes through these underground ditches.

Sixth: In case there is lack of water, this system will save enough above any other system known to enable us to grow cover crops which may be turned under at the proper period and thus fertilize the soil.

These reasons urged by some who advocate that system are not universally accepted; for on the other hand it is argued:

First: That while there is less evaporation, the loss by drainage is greater often than by evaporation.

Second: While it is true that the tendency of the root system is toward the water, yet the feeding roots are naturally near the surface, and the water should be placed where they are.

Third: In case a surface coating of manure is given, surface irrigation carries the fertility downward to the roots, whereas by the underground method, alkali and other injurious substances are lifted to the surface by capillarity.

FACTORS DETERMINING DUTY OF WATER

F. E. Jones

The method of applying water is an important factor, for it has been found that furrow irrigation saves more water than the flooding method, and deep furrows have an advantage over shallow ones. Sub-irrigation is not practical, but results in a great saving of water over the other methods of application.

The method of planting enters into the amount of water required to mature the crop, for if crops are planted thinly, less water will be used; the amount of shade produced by the plant affects the evaporation; and a cultivated crop will conserve more moisture than an uncultivated one.

Kind of tillage. In order to be most effective, cultivation must be promptly done after the water has been applied, for as much water is lost in the first 24 hours as is lost in the three days following. On heavy soils it is necessary sometimes to wait two or three days.

The kind of ditches. Small, shallow ditches result in a great percentage of loss.

The skill of the irrigator. This is one of the most important factors in determining amount of water used.

The amount and frequency of irrigation is a factor in the duty of water, for the land must be very level to make it possible to use as little as two inches of water at one irrigation. As a rule, a four or five inch irrigation will thoroughly wet a soil as far as the roots of ordinary crops go. Heavier amounts neces-

Fig. 3. Artesian Well Near Walla Walla, Washington. 579 feet deep with flow of 2,224 gallons per minute. 62 pounds pressure.

sary for meadow than for cultivâted crops.

Method of purchase. The best plan is to practice rotation in the use of water, and make the best use of the water while it is on the farm. The highest duty is obtained by this method rather than by having a continuous stream during the season.

Summary. A low duty of water is due to excessive appropriation, bad contracts, loss by seepage and careless irrigation. The duty of water may be increased by preventing seepage, draining the land, providing for rotation in use, and charging for the quantity received.

Amount and Frequency of Irrigation

In irrigation practice it is important that the irrigator know the amount of

water necessary for the crop and the frequency with which it should be applied. The conditions which determine the amount of water that should be applied at a single irrigation are as follows:

(a) *Amount*—

1. *The capacity of the soil and subsoil to store water.* The question that confronts the irrigator is what quantity of water can be stored in the soil for the proper growth of the plants. The range for sandy soils will be between 5 per cent and 15 per cent, the optimum being about 10 per cent In clay loams it is safe to say that it is impossible to store more than 30 pounds (a half foot) in the first four feet of a silt soil. If the amount of water in the soil is not down to the wilting point of plants at the time of application of water, the soil will not take up the maximum amount.

The following table shows the lower and upper limit of storage capacity of a clay soil, and the available moisture for use of plants in each foot of the soil:

Clay Loam Soil—

Depth	Lower Limit	Upper Limit	Available Moisture, Lbs
First foot	17.01%	25 77%	6.92
Second foot	19.86%	24.3%	4.11
Third foot	18 56%	24 03%	5.72
Fourth foot	15 9%	22.29%	6.786
Total pounds per cubic foot			23 54

2. *The depth of the soil stratum penetrated by the roots* of the particular crop. If the roots of a crop penetrate deeply a larger amount of water may be applied to the soil without a large amount of it going beyond the reach of the roots. If the roots grow to the water the plants will not need to wait for the water to come to the roots. Plants probably root deeper in arid soils and may be encouraged to do so by cultivation of the soil about six inches in depth. Plants have been found to penetrate the soil with their roots to depths as follows:

Apples	9 feet
Strawberry	22 inches
Alfalfa, 174 days old	5 to 30 feet

3. The *rate at which the soil below the root zone* may supply water by upward capillarity to the roots. The necessary moisture may be below the roots, but will not travel up fast enough.

4. *The extent to which the soil and subsoil may become dried out.* If at the time of irrigation the soil is very dry it is capable of taking up a large amount of water. The texture of the soil will also have an effect on this factor.

(b) *Frequency.* This is one of the most important questions that confronts the practical irrigator. The conditions which determine the frequency of irrigation are:

1. *The amount af available moisture* which may be stored in the soil. If the difference between the upper and lower limit is only a few per cent it will determine the amount of water stored at one time.

2. The *rate at which the moisture is lost through the crop* and through the soil. As to the crop it sometimes is necessary to irrigate to bring up the seed. A young crop will make very little demand on the water in the soil. A wheat crop makes the heaviest demand on the soil from the time it begins to head until it reaches the dough stage.

3. The *degree of saturation* a particular *crop will tolerate* before it is injured in quality and quantity. Irrigation will nearly always check the growth of the crop for a few days. The fewer the number of irrigations the smaller may be the labor involved and the lower the cost. A heavy soil will store water longer, usually, and will require fewer irrigations.

METHOD OF IRRIGATING WITHOUT WASTE WATER

H. M. Gilbert

There is considerable alarm among those inexperienced in irrigation over the suits, court injunctions and threatening notices sent out by various canal companies. The accompanying illustrations will suggest to the irrigator how he can greatly lessen, and in many locations entirely stop, the running of waste water from his land.

The solution to the whole proposition of waste water is: level contour ditches made with a two-horse plow at the lower end of the irrigation rows.

These level contour ditches should be sufficiently near together to irrigate the

portion of orchard they cover. Ordinarily they should cover 10 to 30 per cent of the orchard, the larger proportion being where the hillsides are steeper or where the irrigator wants to irrigate hurriedly, and therefore has a large quantity of waste water to care for.

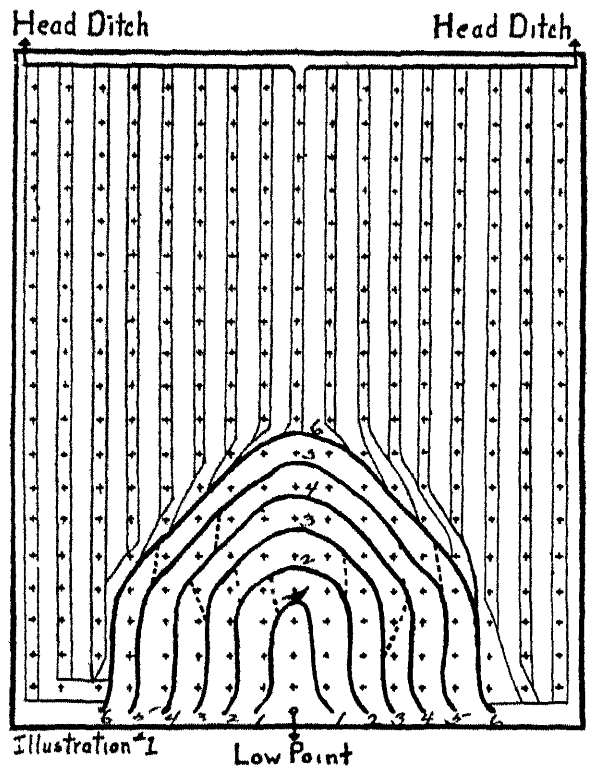


Illustration No. 1 is for a field where the general slope is in one direction with low point in or near the middle of low side. Heavy lines indicate large furrows made with two-horse plow on contour levels These heavy lines represent practically level ditches.

Illustration No. 2 is where the slope is in two directions with low point at one corner. Here again heavy lines indicate large furrows made with two-horse plow.

To locate these level contour ditches place an instrument at low point, then take stakes numbered 1, 2, 3, etc , and place them on the two boundary lines at elevations six inches, one foot or two feet apart, according to the steepness of the field. Then turn the instrument up the diagonal row and place another line of stakes numbered 1, 2, 3, etc., on the same levels as those on the boundary. By placing these stakes along the fence row or under the trees they can be left throughout the season. In this way the ditches can be cultivated over and remade for the next irrigation without the use of any instrument or running of levels.

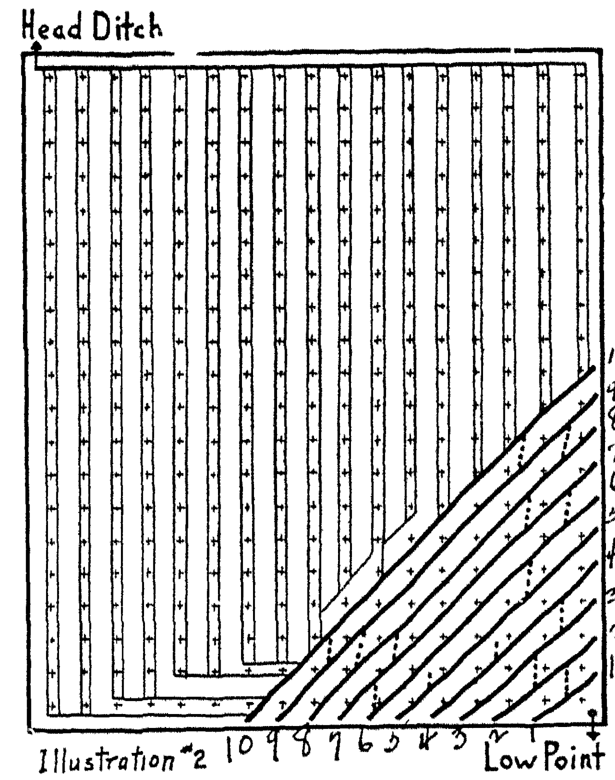
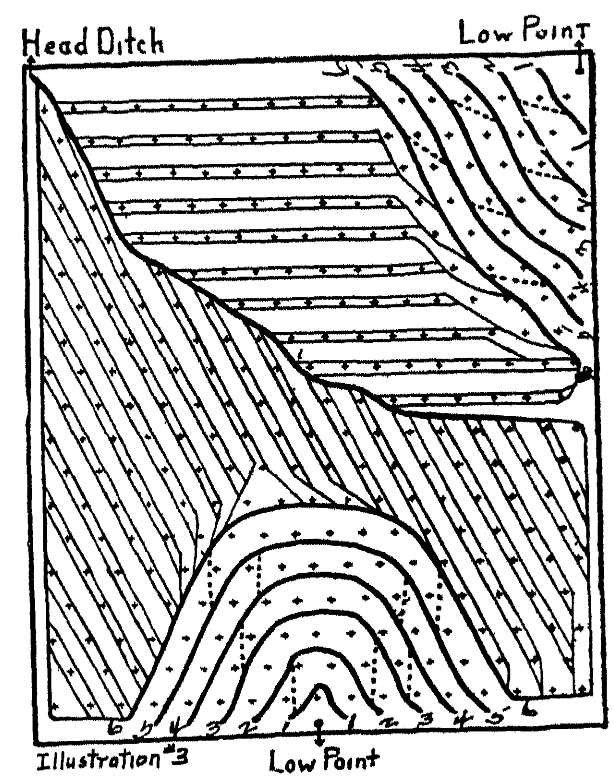


Illustration No. 3 shows a head ditch running on a ridge diagonally through the tract, feeding irrigation rows on either side on different slopes. You will note there are two low points on this tract, requiring that there be two sets of contour ditches. The level, however, is set as in Illustrations Nos. 1 and 2, at the lowest point, and the contour levels ascertained in the same manner.

Illustration No. 4 shows two sorts of home-made levels. Either of these will be sufficiently accurate for running these contour lines. Of course, a surveyor's



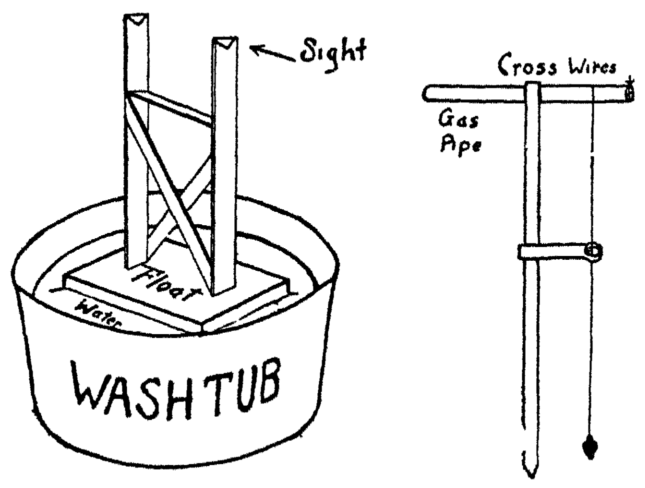


Illustration #4

level would be preferable, and an architect's level can be procured at a cost of about $50.00. The agricultural papers are also advertising a level for $15.00, which would no doubt be sufficiently accurate. In addition to this, any farmer can take a pocket level or a carpenter's level and with a little ingenuity locate the necessary points sufficiently accurate.

The illustrations here given will not meet the exact situation in many tracts, but any irrigator can make it possible to apply the plan to any tract.

The advantages of no waste water are:

1. Freedom from damage suits, court injunctions and attorneys' fees.

2. The saving of water and using it on your own land, better irrigation with the same amount of water.

3. Saving soil fertility, not leaching off the best elements and running them off to the ocean.

4. No swampy spots and no drainage necessary on your own land, for you will not run any of your furrows to the low points. In fact, by keeping up contour furrows at low points, where they cross ravine or swale, you can keep the water out of low points.

Head Ditches

Proper arrangement of head ditches will greatly assist. Where there is more than two inches fall to the rod in your head ditch, use board flumes made of 1⅛-inch or 1¼-inch fir, rough. I have used such a flume for 13 years before it rotted out. Bore holes one inch in diameter to let out water for irrigation furrows. Control size of opening by galvanized iron slides to be obtained from hardware stores at small cost, as they are made from scraps. Level head ditches where possible are the most economical and efficient.

SUMMARY OF USEFUL INFORMATION

The following summary of useful information has been gathered from various sources:

Doubling the diameter of a pipe increases its capacity four times.

Double riveting is from 16 to 20 per cent stronger than single riveting.

A cubic foot of water contains seven and one-half gallons, which is equal to 1,728 cubic inches.

To find the pressure in pounds per square inch of a column of water, multiply the height of the column in feet by .434.

The weight of a cubic foot of water at 32 degrees Fahrenheit is 62½ pounds.

A gallon of water weighs eight and one-third pounds

To find the total pressure of water on any surface multiply its area in square feet by the vertical depth of its center of gravity below the water surface in feet, and the total by the weight of one cubic foot of water.

The pressure of air at sea level is 14 73 pounds on each square inch of surface, therefore a cubic inch of air will sustain a column of water 34 feet high.

Factors Affecting the Flow of Water

There are certain factors affecting the flow of water. One is that the smallest inclination to either side, or any winding or changing of the direction of the stream, affects the rapidity of the flow. Any bend in a pipe that deviates from the perpendicular will retard the velocity of the flow of water

The length of a vertical fall will affect the force or momentum, because water, like other bodies, gains momentum with the distance it falls.

Another factor affecting flow, is the friction of the sides. If weeds are allowed to grow along the sides of a ditch; if the sides are irregular in shape; if there are obstructions of any kind; or in

the case of pipes, the material out of which it is made determines in some degree the amount of friction. Wood pipe is supposed to have less friction than cement pipe, and iron pipe less friction than wood.

To find how much water will discharge at a given point, multiply the velocity by the cross section in square feet, which gives the number of cubic feet per second of time.

A second-foot of water on ordinary soil will irrigate from 80 to 160 acres.

The water necessary to mature certain kinds of crops is estimated as follows:

Tomatoes, 24 inches in depth over the ground, or two acre-feet. Potatoes, 17 inches; onions, 36 inches; strawberries, 27 inches.

Orchards of tree fruits are variously estimated, depending on the climate, soil, kinds of fruits and the age of the trees. Young orchard trees can be grown with less than half the water required for old trees in full bearing.

One foot deep per acre is 43,560 cubic feet, equal to the number of square feet per acre.

IRRIGATION OF ORCHARDS

It is impossible to give any correct rules for irrigation that will apply to all cases. There are so many conditions of soil, rainfall, seepage, climate and kinds of crops that the orchardist must necessarily learn from the experience of others who have lived for a considerable time in the community where the orchard is located. However, the following may be helpful in determining the amount of water needed.

Varieties which mature their fruits early require less water than those which mature late. For this reason cherries, early peaches, prunes and apricots require less water than late peaches, pears and winter apples.

The non-deciduous fruits require more water than those which drop their leaves in autumn, not only because there is little evaporation from the tree during the winter, but because of climatic conditions. There are, however, exceptions to this rule, for the leaf and root system of the olive are so constructed that they will bear with less water than is required for the peach

More water is required for large than for small trees, and the larger the tree, other things being equal, the more water required. Shallow rooting trees will generally require more frequent irrigation than those of the deep rooting habit.

Trees with tap roots, such as apples and pears, must be irrigated with special reference to the supply of water for the tap roots as well as the lateral roots.

In the fine volcanic-ash soils, in adobe, or in scab soils that puddle or cement, or harden when dry, or in any other way tend to become impervious to the air, there should be more than usual care to see that the water goes below the roots, and that the soil is sufficiently aerated. This may be done by growing alfalfa, or dynamiting the soil, or by digging holes to considerable depth to let the water down below the puddled section.

Where the water does not penetrate about the roots of the trees, there will be manifestations of disease such as die back, yellows, rosette, etc. These may also result from excess of water. Lack of moisture may also prevent bearing the following year, since it may prevent the proper development of fruit buds.

Irrigate the Center

For a number of years the general practice, in irrigating an orchard, was to run the laterals about three feet apart between the rows of trees with the lateral nearest the tree not nearer than two and one-half feet. This left the center of the space in which the tree stood without a lateral. The laterals on either side being two and one-half feet from the tree row made a space of five feet occupied by the tree row. This seems to be all right for the lateral roots, which tend to reach out toward the center, but it leaves the tap roots often without water. In making some experiments, we found that when the center was watered by a small lateral, made with a shovel, that this lateral required much more water than either one of the others. This suggested

the idea that the water followed the tap root to greater depth, and also that there was considerable ground immediately about the tree which had not been wet.

Alkali Between the Laterals

It is the experience of irrigators that where there is alkali in the soil the process of irrigation tends to wash it away from the center of the ditch toward a point about midway between the laterals. It is not uncommon to see strips of white alkali encrusted on the surface at regular distances apart, according to the distances of the laterals. As a result of this, the method of neglecting to irrigate the center of the space in which the trees stand is one which drives the alkali toward the tree. In soils where the alkali is strong enough so that it approaches the point of injury to the tree, concentrating it at the center might injure the bark and tender roots near the surface. We had four specimens of soil analyzed and found that there was much more alkali in the surface soil near the tree than a specimen of soil taken from the center of the ditch, or than at one foot depth below the surface.

We have been of the opinion that the crust of alkali injured the bark of the young growing tree and caused it to crack, exposing the cambium and rendering it susceptible to the attacks of insects. Our opinion was based upon the number of instances where these conditions of injury occurred in soils strong in alkali, where this method of irrigation was practiced. This opinion is not sustained by the authorities and is advanced as one that is yet to be proven by experiments.

We know that we are right in so far as it concerns the irrigating of tomatoes and other tender plants, but as to whether the bark of the young tree is sufficiently resistant so that it would not be injured by a strong encrustation of alkali in the soil about it, is a question that can be determined better by experience in the orchards than by any other method.

However, for other reasons, if not for this, we would recommend irrigating the center in which the trees stand, and since the laterals cannot be made with a plow or other instrument commonly used for such purpose, we would take the more laborious method of making them with a shovel, and irrigate about the body of the tree, thus killing a number of insects that might work injury, letting the water into the soil about the tap roots, and driving the alkali away from the tree.

GRANVILLE LOWTHER

Cost of Pumping

One pumping plant, unique in its unusual sprinkling system, is thus described by the owner, Mr. F. B. Allard:

"I have a pumping plant with which I am watering 11,000 apple trees. I am doing it in the following manner:

"I first pump it into a railroad water tank, then I have one mile of four-inch steam pipe connecting the tank with every ten-acre tract with hydrants at different places. On this main line of pipe and 100 feet apart I have uprights starting with one-inch pipe and reducing to three-quarters, 30 feet high, with a whirling sprinkler on each of them, which is forced to run by means of a double-stroke force pump, which takes the water out of the big tank and puts it into the main pipe at 100 pounds pressure, and this spray is carried on one side by the breeze in the forenoon and in the opposite direction in the afternoon, wetting a strip of ground 300 feet wide and one mile in length, or a strip of ground equal to 40 acres, on which I am raising alfalfa between the trees.

"From the bottom of the well to the top of the tank it is 160 feet. My gasoline bill last year was $150, or 1.4 cents per tree and 99 cents per acre. This year it was $225 or 2.29 cents per tree, and next year it will be about $300 or 2.73 cents per tree, and I figure that when the trees have reached the age of six years they will require about $500 worth of distillate, or 4.54 cents per tree—figuring that the price on the distillate remains the same as at present

"I am going to connect every tree with the main line of pipe with a smaller

pipe. Part of this is done now; then I will be able to take care of the orchard with about one-fourth the cost of doing it the old-fashioned way."

Cost of Pumping from Well

The cost of installation and maintenance of a pumping plant in the Moses Coulee District, Washington, is thus reported by Mr. H. G. Otis:

"My well is 397 1-3 feet deep. It is 224 feet from the surface of the ground to the water. The well is 10 inches inside diameter and takes a casing 8⅝ inches. I have a 32-H.P. Fairbanks-Morse oil-burning engine and a No. 30 Pomona pump head. The cylinder is 8 inches, double stroke. The casing is 275 feet, so that the cylinder is immersed about 50 feet in the water. The well furnishes all the water we can pump, of a very excellent quality. The cost of drilling the well was $6 per foot for the first 300 feet and $6.50 for the 97 1-3 feet. The cost of the engine and pump complete is $3,100.

"We can run on three gallons of oil per hour and the oil costs, laid down at Quincy, 7½ cents per gallon. I pay my engineer $2.00 per day and board and it takes very little of his time in running the plant. He can put in most of his time attending to irrigating.

"The plant furnishes 310 gallons per minute and we figure that this will furnish water for 160 acres. I will have the land well piped and try to economize as much as possible. My well house is 18x42 with a concrete floor. The installing of the plant cost about $200. The work is very well done and on a solid concrete base. We have installed 2,500 feet of 6-inch inside diameter concrete pipe with bell-shape ends. We have 2-inch and 1-inch outlets which we use in irrigating trees or alfalfa. This pipe cost 20 cents per foot F. O. B. Quincy. The freight on the 2,500 feet was $80. We are now installing 3,600 feet of 6-inch and 5-inch galvanized tin pipe which cost 15 cents for the 6-inch and 12½ cents for the 5-inch F. O. B. Wenatchee. We like the tin pipe a great deal the best.

"The cost of pumping is about $4 per acre. I would suggest that on a large scale the work could be done at less expense and would suggest that several farmers go in together to put down a large well and a large engine with electric motor and run the pump and all other machinery on the farm by electricity. This I think is a far better way."

Fig. 4. Pumping Plant of Mr. F. B. Allard. Standpipe to left has a sprinkler at the top.

Cost of Pumping Water for Irrigating

On the cost of pumping water for irrigating purposes, Elwood Mead of the Government Service made investigations which clearly set forth the cost of furnishing water to land under various systems of pumping, as follows:

Summary of Data Concerning Cost and Duty of Water Under Sixty Pumping Plants in Santa Clara Valley in 1904

No. of plant	Power	Discharge	Area watered	Amount of water raised during season	Depth of water applied during season	Height water raised	Cost of water per acre	Cost of water per acre-foot	Cost of raising 1 acre-foot of water 1 foot (i. e., per foot-acre-foot)	Total cost of water for season
		Cu. ft. per sec.	Acres	Acre-feet	Feet	Feet				
1	Steam..........	1.56	150	315.4	2.10	110	$10.50	$ 4.99	$0.045	$1,575
2	do	1.10	19	35.6	1.87	50	10.37	5.54	.111	197
3	do	.76	23.5	13.4	.57	140	5.83	10.22	.073	137
4	do	2.34	25	38.7	1.55	28	5.96	3.85	.137	149
5	do	2.34	15	14.5	.97	28	3.73	3.86	.138	56
6	do	2.55	30	31.6	1.05	22	3 77	3.58	.163	113
7	do	.90	22	11.6	.53	70	3.59	6.81	.097	79
8	do	1.18	12.5	14	1.12	58	5 60	5.00	.086	70
9	do	1.18	15	9.7	.65	58	3.20	4.95	.085	48
10	Gas............	.72	12	14.4	1.20	50	8.33	6.94	.139	100
11	Steam..........	1.42	85	54.7	.64	75	3.80	5.90	.079	323
12	Gas............	.92	22.5	17.8	.79	27	2.58	3.26	.121	58
13	Steam..........	1.04	18	5.1	.28	86	2.17	7.65	.089	39
14	Gas............	.98	30	54.1	1.80	77	11 40	6.32	.082	342
15	do	.72	25	14.3	.57	27	3.00	5.24	.194	75
16	Steam..........	1.88	34	21.2	.62	68	2.44	3.92	.058	83
17	Gas............	.45	24	10.8	.45	44	1.83	4.07	.093	44
18	Steam..........	.75	20	16.6	.83	24	5.55	6.69	.279	111
19	do	1.93	38	70.6	1.86	115	7.16	3.85	.034	272
20	Gas............	.53	18	17.4	.97	46	6.89	7.13	.155	124
21	Steam..........	1.23	50	26.5	.53	88	3.34	6.30	.072	167
22	do	1.32	55	74.5	1.35	88	5.96	4.40	.050	328
23	Gas............	1.34	75	107.9	1.44	24	3.33	2.32	.096	250
24	do	1.01	25	19.4	.78	27.5	1.44	1.86	.067	36
25	Steam..........	2.83	70	70.2	1.00	19.5	2.53	2.52	.129	177
26	Gas............	1.29	10.5	49.4	4.70	52	8.95	1.90	.037	94
27	do	1.29	11	46.5	4.23	52	8.09	1.91	.037	89
28	Steam..........	2.56	30	39.7	1.32	37	3.30	2.49	.067	99
29	Gas............	2.07	19	44.2	2.33	43	4.21	1.81	.042	80
30	do	2.07	16	24.5	1.53	43	2.81	1.84	.043	45
31	Electric........	2.11	15	31.3	2.09	34	5.67	2.72	.080	85
32	Steam..........	.93	23	28.8	1.25	49	7.30	5.83	.119	168
33	do	.92	21	16.6	.79	55	4.86	6.15	.112	102
34	do	2.53	20	48.2	2.41	60	5.75	2.39	.040	115
35	do	1.30	40.5	21.9	.54	93	4.52	8.36	.090	183
36	do	1.55	24	22.4	.93	73	3.75	4.02	.055	90
37	do	2.17	10	23.6	2.36	91	21.80	9.24	.101	218
38	do	1.22	20	13.6	.68	121	3.65	5.37	.044	73
39	do	1.29	35	26.8	.77	100	6.83	8.92	.090	239
40	do	1.31	85	36.4	.43	85	2.56	5.99	.070	218
41	Gas............	.82	70	33	.47	53	3.11	6.61	.125	218
42	Steam..........	1.87	40	45	1.13	80	9.18	8.15	.102	367
43	do	.81	73	29	.40	118	3.07	7.72	.065	224
44	Steam..........	2.23	150	158.5	1.06	44	2.47	2.33	.053	370
45	do	1.22	33	57.6	1.75	91	11.42	6.54	.072	377
46	do	2.13	60	60.6	1.01	50	2.58	2.56	.051	155
47	do	1.87	35	36.2	1.03	38	3.14	3.04	.080	110
48	Gas............	1.17	35	28.9	.83	46	3.34	4.05	.088	117
49	do	1.23	45	72.6	1.61	38	6.24	3.87	.102	281
50	Steam..........	1.86	34	55.4	1.63	40	5.09	3.12	.078	173
51	Gas............	.22	30	14.6	.49	23	2.93	6.03	.262	88
52	do	1.35	15	9.4	.63	63	2.13	3.40	.054	32
53	Steam..........	1.15	41.5	27.6	.66	102	4.17	6.27	.061	173
54	Gas............	1.23	35	38.6	1.10	50	6.83	6.19	.124	239
55	Steam..........	2.70	139⅓	202.3	1.45	60	3.76	2.59	.043	524
56	Gas............	.13	14	2.3	.16	43	1.00	6.09	.142	14
57	Steam..........	1.75	43.5	45.6	1.05	59	6.14	5.86	.099	267
58	Gas............	.58	21	9.5	.45	107	3.81	8.42	.079	80
59	do	.71	24¼	20.6	.85	115	4.79	5.63	.049	116
60	Steam..........	.85	40	67.2	1.68	110	12.12	7.22	.066	485
	Totals or averages......	....	2,272.1	2,568.4	1.13	66	4.96	4.38	.066	11,261

See office of Experiment Stations, Bulletin 838, "Irrigation and Drainage Investigations."

Cost of Water Per Acre

C. J. Blanchard,
Statistician United States Reclamation Service

1. The cost per acre of water rights or of water for irrigation in the arid region, under the present conditions of construction, is far higher than is usually appreciated. During earlier decades, before any considerable number of large irrigation canals had been built, it was a relatively simple and inexpensive matter for farmers to join together and build small canals that could be enlarged as the demand for water increased. All such easily available opportunities, however, have been utilized and development has proceeded to a point where on most of the recent irrigation systems it has been necessary to provide storage, thus adding materially to the cost.

2. There has also been a notable increase in the cost of labor and of materials used in construction. This condition has been pointed out in various hearings before Congress, notably in the series before the Ways and Means Committee of the House of Representatives at the time of the granting of the $20,000,000 loans. It is there shown, notably in a statement submitted by Representative Mondell that one of the arguments for increase of the reclamation fund was in the fact that common labor had advanced from the time of the preparation of the plans for works in 1903 and 1904 from 20 per cent to 50 per cent, and that the efficiency of such labor had fallen off in greater proportion. Costs were also affected by the increased price of materials and equipment.

3. The following table gives in condensed form lists of some of the recently constructed and proposed larger private projects and Carey-act projects. These figures, obtained from printed reports of state engineers and public data show that on over 90 modern irrigation systems being built by private or corporate capital the cost per acre averages nearly $53. This cost does not include the annual cost for operation and maintenance.

4. The cost to the settler is increased by the fact that payment is made on most of these projects in instalments bearing interest at 6 per cent or even more. The total payments made for such a water right with simple interest at 6 per cent would be about $70.50 per acre on the basis of ten equal annual instalments of the principal as compared to $53 without interest.

COST OF PRIVATE IRRIGATION PROJECTS

Name of Project or Company	Acreage in project	Cost of water right charge per acre [1]
Colorado—		
[2]Amity Canal	80,000	$100
[2]Beaver Land & I. Co.....	20,000	175
Catlin Canal	25,000	100
Colorado Co-operative Co.	5,200	60
Denver Resv. & I. Co...	200,000	45
East Palisade I. Dist...	645	63
[3]Fort Lyon Canal	70,000	100
[4]Grand Valley Canal	40,000	60
Greely Poudre I. Co.....	125,000	45
Mesa Co. Irrigation Dist.	2,568	73
Orchard Mesa I. Dist....	9,122	119
Otero Irrigation District	20,000	40
Palisade Irrigation Dist.	6,000	41
Paradox Valley I. Co...	30,000	45
[5]Pueblo-Rocky Ford I. Co.	100,000	150
[6]Redlands I. & P. Co.....	5,000	100
Routt Co. Dev. Co.......	39,000	45
S. Palisade Hghts I. Dist.	700	127
Montana—		
Conrad Land & Water Co.	......	40
Great Falls Land & I. Co.	36,000	50
Nebraska—		
[7]Belmont Canal & I. Dist.	20,000	25
Tristate Canal	60,000	42
New Mexico—		
French Land & I. Co.....	40,000	50
Oregon—		
Bonanza Project	20,000	39
Eagle Valley	21,700	80
[8]Turnish	6,000	60
Paradise	100,000	60
Willamette Valley	20,000	50
South Dakota—		
Red Water I. Ass'n.....	4,000	40
Utah—		
Provo Reservoir	12,000	80
[9]Utah Lake Pumping....	8,000	40
Washington—		
Cascade Canal Co.......	10,000	50
Congdon Canal Co.......	4,200	121
Kennewick Canal	14,000	163
Lower Yakima I. Co....	12,500	129
Selah-Moxee	7,000	86
Selah Valley Dev. Co...	10,000	150
Union Gap I. Co.	5,000	135
Washington I. Co.	50,000	46

[1] Engineers' estimates where project is proposed or incomplete.
[2] Estimated at from $75 to $150 per acre. Includes land.
[3] Estimated at from $75 to $150 per acre.
[4] Per miner's inch.
[5] Includes land.
[6] Estimated at from $65 to $150 per acre.
[7] For river rights only. Purchaser of Pathfinder Reservoir water will increase this to $35.
[8] Estimated at from $50 to $70 per acre.
[9] Estimated at from $40 to $50 per acre.

COST OF CAREY ACT PROJECTS

Name of Project or Company	Acreage in project	Cost of water right charge per acre [1]
Colorado—		
Gt. Northern I. & P. Co.	2,121	$ 55
Colo. Realty & Sec. Co.	45,875	45
Toltec Canal Co.	14,853	40
Colo. Ld. & Wat. Sup. Co.	16,278	45
Two-Butte I. & R. Co.	22,000	35
Valley Investment Co.	24,000	60
Idaho—		
American Falls C.&P. Co.	57,242	40
Big Lost River I. Co.	78,242	40
Birch Creek I. Co.	20,000	50
Blackfoot N. Side I. Co.	22,280	..
Black Canyon I. Dist.	98,492	72
Blaine Co. I. Co.	14,720	40
Boise City Carey Act Project	151,000	..
Bruneau Irrigation Co.	40,000	60
Emmett Irrigation Dist.	5,800	50
Grandview Extension Irrigation Co.	1,000	65
Grassmere Irrigation Co.	47,500	65
Hansen, C. V., Mackay Project	3,456	40
Hegsted, Victor, Project.	3,410	40
High Line Pump. Co., Ltd	3,860	45
Houston Ditch Co., Ltd.	1,884	35
Idagon I. Co., Ltd.	9,000	60
Idaho Irrigation Co., Ltd.	130,000	50
Keating Carey Land Co.	15,597	30
Kings Hill Ext. I. Co.	9,655	65
Kings Hill I. & P. Co.	13,359	65
Lemhi Irrigation Co.	3,500	50
Little Lost River Land & I. Co.	20,000	30
Marysville Canal & Imp. Co., Ltd.	6,134	20
Owsley Carey L. & I. Co.	8,600	35
Owyhee L. & I. Co.	29,535	55
Owyhee I. Co., Ltd.	3,296	45
Pahsimerai Project	6,000	30
Portneuf-Marsh Valley I. Co.	11,914	35
Pratt I. Co., Ltd.	4,674	40
Snake River I. Co., Ltd.	6,500	50
Thousand Springs L. & I. Co.	6,300	30
Twin Falls L. & W. Co.	244,000	25
Twin Falls North Side L. & W. Co.	207,144	45
Twin Falls Oakley L. & W. Co.	45,000	65
Twin Falls Raft River I. Co.	99,668	50
Twin Falls, Salmon River L. & Water Co.	127,707	40
West End Twin Falls I. Co.	46,000	50
Montana—		
[10]Billings L. & I. Co.	27,000	40
Big Timber Project	17,194	60
Valier Project	115,100	40
Oregon—		
Central Oregon I. Co.	139,204	40
Central Oregon I. Co.	74,198	60
[11]Columbia Southern Co.	27,000	50
Deschutes Land Co.	31,082	36
Deschutes Reclamation & Irrigation Co.	1,280	40
Desert Land Board	27,000	..
Portland Irrigation Co.	12,000	46
[12]Powder L. & I. Co.	65,000	100
Utah—		
[13]Mosida Pumping Plant.	9,000	150
Wyoming—		
Big Horn Co. I. Co.	20,411	50
Boulder Canal	6,120	30
Burch Canal	35,887	50
Carbon Co. L. & I. Co.	7,793	30
Cody & Salisbury Canal	77,199	..
Cody Canal	26,429	50
East Fork I. Co.	4,901	30
Eden L. & I. Co.	95,658	$ 30
Elk Canal	2,724	30
Fisher Ditch	320	10
Green River L. & I. Co.	75,257	35
Hammitt Canal	6,295	60
Hanover Canal	10,682	50
Hawk Springs Project.	12,238	50
Hubbard Canal	38,604	40
James Lake I. Co.	14,554	35
La Prele Ditch & Reservoir Co.	18,558	50
Lovell Irrigation Co.	11,320	25
McDonald Canal	15,159	50
Medicine Wheel Canal Co.	22,385	30
North Laramie Canal Co.	4,133	50
North Platte Canal & Colonization Co.	14,424	30
Big Horn Basin Dev. Co.	204,650	50
Paint Rock Canal	53,162	50
Platte Valley Canal	18,171	30
Rock Creek Irrigation Co.	11,696	45
Sahara Ditch Co.	7,920	50
Sidon Canal and ext's	20,559	30
Tinsleep-Bonanza Canal.	16,486	40
Uinta Co. I. Co.	26,000	35
Wheatland Industrial Co.	33,115	45
Wyoming L. & I. Co.	4,526	50

[1] Engineers' estimates where project is proposed or incomplete.
[10] Estimated at from $20 to $60 per acre.
[11] Estimated at from 50 to $60 per acre.
[12] Estimated at from $75 to $200 per acre.
[13] Estimated at from $100 to $250 per acre, including land.

5. For comparison with the costs of the foregoing private and Carey act projects there is given in the following table a partial list of the projects being built under the terms of the Reclamation act showing the total acreage in them and the charges for water rights for completed portions of such projects as far as these have been fixed by public announcement of the Secretary of the Interior. These figures are seen to average a little over $41 per acre:

Project	Approx. acreage	Cost per acre From	Cost per acre To
Arizona-California—			
Yuma	131,000	$55	$66
Idaho—			
Minidoka	118,700	22	30
Montana—			
Sun River	216,346	30	36
Montana-North Dakota—			
Lower Yellowstone.	60,116	45	..
Nebraska—			
North Platte	129,270	45	55
Nevada—			
Truckee-Carson	206,000	22	30
New Mexico—			
Carlsbad	20,277	32	45
Oregon—			
Umatilla	25,000	60	70
Klamath	72,000	30	..
South Dakota—			
Belle Fourche	100,000	30	35
Washington—			
Okanogan	9,900	65	..
Sunnyside	102,824	52	..
Tieton	34,613	93	..
Wyoming—			
Shoshone	164,122	45	50

6. It is interesting to note that the average cost of water from the government works is about $12 per acre less than from the recent private works of comparable size. The real difference is still greater because of the fact that deferred payments on government works do not draw interest.

7. This difference is further accentuated by the greater probability of the water users under the government projects receiving an adequate water supply, as this matter has been given more careful consideration and deficiency guarded against with greater care than in the private investments. In fact it is known that in a few cases at least there is not water enough for the entire area of land included in these private projects. Also on the government works provision in many cases has been made for drainage such as has not been provided by the private works and the water is, as a rule, brought nearer to the land to be irrigated, still further reducing the cost to the water user.

8. Summing up all of these advantages —lower first cost, absence of interest, more dependable water supply, and more complete works—it would appear to be fair to state that water from the government projects is obtained at from half to two-thirds the cost of that from private works here listed, including those built under the terms of the Carey act.

WINTER IRRIGATION

In a general way lands in irrigated districts are not irrigated in the late autumn, winter or early spring. The water is turned out of the irrigating ditches in October or November and then turned on again in March or April, depending on the climate, the amount of rainfall during the winter, the soil and the kinds of crops grown. While the water is out of the ditches is an opportune time for repairs, cleaning the ditches and other work for the irrigation of grounds the following year. However, there are conditions where irrigation would be practicable in winter, and there are some reasons why it is desirable. One reason why it is desirable is that there is a larger water supply in winter than in summer, and this, in places where water is scarce, is an important item.

Another reason is that there is less evaporation in winter than in summer, and this is another important item where water is scarce, a larger per cent being left to percolate through the soil.

A third reason is that in winter irrigation the land does not bake and need cultivation as in summer.

A fourth reason is that there is sufficient time for a deep, thorough wetting, which in some soils is much needed.

A fifth reason is that an amount of water which in summer would injure the little root hairs will do little if any injury in winter during the dormant period of the tree.

A sixth reason is that heavy winter irrigation will retard the blooming period for a few days in spring and tend to lessen the injury from frosts.

Winter irrigation to be of any considerable value must be given when the ground is not frozen.

It is not here argued that winter irrigation is to take the place of summer irrigation, but that it might be made to supplement it and, in some places, a good irrigation in winter is all that would be needed for a crop and the summer irrigation might be dispensed with altogether. For instance, in a country where there is approximately 25 inches of rainfall per annum a good deep irrigation before the ground freezes in winter or after it thaws in the spring would enable the fruitgrower to develop a good crop of apples, whereas that amount of rainfall is not sufficient in ordinary soils.

Granville Lowther

IRRIGATION IN HUMID REGIONS

J. F. Duggar

The size of the crop is more dependent upon the amount and distribution of the rainfall than upon soil, fertilizer, or any other factor. Man cannot entirely regulate the supply of moisture, but by means of irrigation and drainage he can do much to make the moisture conditions in the soil such that crops will make their largest growth. Irrigation and drainage

must go together, at least on soil not naturally well drained.

The unexampled prosperity of the West and the fact that it grows larger crops per acre than any other portion of the Union is due chiefly to irrigation. The practical question is: "Do we in a humid climate need irrigation?" Fortunately we do not need it every year. But there do come years when we need it sorely. Two diagrams were published in Bulletins Nos. 11 and 134 of the Alabama Experiment Station showing the rainfall at Auburn during the last ten years. From these we see plainly that there have been frequent periods during the growing season when for two or three weeks or longer there has been no rain of consequence and when crops suffered for want of water.

It must be said that there will never in the Mississippi states be a general need for irrigation as a means of growing the larger area of field crops. But the farmer working on an extensive scale can utilize irrigation of small areas even for his rather low-priced crops. Irrigation is more advantageous to the man who grows a crop selling at a high price per acre than it is to the trucker and fruit-grower. Many of the crops that he grows need abundance of moisture not only in order that large yields may be obtained, but also that a large size of fruit or vegetables may be produced. Among farm crops those that would most profit by irrigation are the hay crops and, in the South, sugar-cane.

If any one is inclined to question the advantages of irrigation in humid climates, data given in the bulletins of the Missouri, New Jersey and other experiment stations will convince him of its value.

Examples of increase due to irrigation in the humid climate of Wisconsin:

Crop—	Not Irrigated	Irrigated
Strawberries, qts. per acre	3,496	6,867
Strawberries, qts. per acre	1,030	8,732
Irish potatoes, bus. per acre	290	394
Irish potatoes, bus. per acre	212	334
Cabbage, tons per acre...	20	23
Corn, dry weight, entire plant, tons	3.8	5.2
Corn, dry weight, entire plant, tons	1.4	5.3
Corn, dry weight, entire plant, tons	4.1	5.2
Corn, dry weight, entire plant, tons	3.4	4.3

There are those who can give their own personal experience as to the value of irrigation in the South.

I have long been a believer in the practicability of irrigation in the South, but had been in much uncertainty as to the character of soils adapted to irrigation until I visited the irrigated valleys of Colorado. After that I was prepared to believe that irrigation, at least in that climate, could be performed on any class of soil. However, I would recommend as best adapted to this purpose our rather level or gently rolling loamy lands. Sandy soils can also be irrigated, but the larger the amount of sand in the subsoil the greater the waste of water, and hence the greater the cost of irrigation by the more common method. To obviate this loss, truckers working very light, sandy soils have sometimes resorted to the method of sprinkling, the chief objection to which is the excessive cost of the iron pipes and the labor of making each application.

Perhaps the ideal soil for irrigation is one in which the surface six or eight inches is of a sandy loam or loamy nature and the subsoil of a denser, more compact texture, permitting a smaller amount of waste by seepage. Even soils quite stiff can be irrigated, but these, of course, bake worse and need greater care in the cultivation that must always follow irrigation just as soon as the surface has sufficiently dried. Cultivation, as soon after irrigating as practicable, so as to prevent the rapid loss through evaporation of the water just applied, is necessary.

Before considering methods of getting water on the land it may be well to devote a few words to the amount of water necessary, since this will largely determine whether or not under given conditions irrigation would be feasible or profitable. We can count on requiring at least enough water so that if spread out it will cover the land to a depth of

two inches, that is, two acre-inches. Frequently the amount applied at one irrigation will be three acre-inches or even four acre-inches. Now to make one acre-inch, that is to cover one acre of land to a depth of one inch, requires about 26,000 gallons of water. Hence, more than fifty thousand gallons are required for a single irrigation. Whether it will pay to lift this amount of water will depend largely on the season and on the value of the crop to be irrigated, and partly too on the cost of getting the water to the land and distributing it after it reaches the field. In Egypt, where no rain falls during the growing season, cotton makes immense yields when irrigated only once in 20 days, and then to a depth of about three and two-tenths inches. Sugar-cane requires much more water, and in the Hawaiian islands water is applied as often as once a week. Probably the man who grows a patch of sugar-cane on bottom land with the expectation of making a large yield through the help of irrigation would be wise to arrange to irrigate it every ten days during periods of very dry weather and at the period of maximum growth. He would probably seldom have occasion to apply the water more than four times per season. For hay crops, such as alfalfa, that afford several cuttings, it is customary in arid regions to water once for each cutting, that is, from three to five times per season. Even with the high-priced fruit crops of California the limited supply of water there is restricting the total depth of water applied throughout the season to about twelve acre-inches. By reason of the scarcity of water these Californians often have to pay to irrigation companies about twelve dollars per acre for this amount of water. In the sections where water is abundant we can get it on the land for a very small fraction of this cost.

EVOLUTION OF PROPERTY RIGHTS IN WATER

The primitive conception that water, like air and sunshine, is one of the gifts of nature which are free to all alike, does not need to be questioned in sparsely settled or uncivilized regions, but this conception must give way when countries become densely populated, or when special industries, like agriculture by irrigation, make so large demands on streams that there is not enough water for all. Free water on Manhattan island is no more a possibility than free forests, and to talk of free water around Denver would be like talking of free coal. Great cities consume enormous quantities of water, the rate of consumption seeming to grow with advancing civilization. It requires all the water of a large territory to meet the needs of cities like New York, Boston and Philadelphia. This consumption necessitates the absorption of streams and the extinction of vested rights in those streams. The common-law doctrine of riparian rights is as unsuited to these conditions as the old-time stagecoach is to the demands of modern travel. Hence new legal remedies must be devised. The last legislature of New York passed two important water laws, which illustrate this. One created a city water commission to ascertain where New York City can obtain a supply of pure, wholesome water. The other created a state commission whose consent must be obtained before any city or town can take a water supply by condemnation. This is state ownership or control of public water supplies far in advance of many arid states. Even in England, with its rainy, foggy climate and a soil requiring drainage because of surplus water, the long-established riparian doctrine is having to give way because of the increasing use of water. To meet the enormous consumption of London, surface and underground streams are being diverted into pipe lines and carried by means of pumps many miles away from the original channels. This is a violation of the common-law doctrine, because under it the rights of riparian lands were inalienable.

In densely populated countries like Italy, Germany, Switzerland and France, the water of streams is under private or public control, notwithstanding the fact that the climate of each of these countries is humid. In cities water is now

used for a multitude of purposes which had no place in the life of primitive peoples. The inventions which led to the use of steam as a motive power enormously increased the consumption and industrial importance of water. Improvements in machinery to utilize differences in level in the generation of power, and the marvelous electrical inventions by which this power is transmitted to remote cities, have given to streams an entirely new and hitherto unthought of value. In nearly every industrial enterprise, great or small, water is an indispensable factor. It feeds the steam boiler, it cools the jackets of steel furnaces, it is the solvent in most chemical processes, and is turned to use and made an agent in the creation of wealth in a multitude of ways which need not be enumerated.

Moisture is necessary to plant growth, and in arid lands this moisture is supplied largely from streams. Hence in such regions the right to use rivers in irrigation is an indispensable requisite to any large creation of wealth in lands. As population increases and civilization advances there is not only a more extensive but a more intensive use of water. The higher the standard of living and the greater the skill of artisans, the greater is the number of needs of the household and the larger the number of uses to which water may be put. So extended have the demands for water become in arid and in many humid sections that the resources of individuals are entirely inadequate to meet them, and great corporations are formed for acquiring water, constructing dams, building storage works, canals, and pipe lines for the conveyance and distribution of water for different purposes. The future of New York City was menaced a few years ago by legislation which gave to a powerful private corporation the exclusive right to acquire water supplies needed or likely to be needed by that city.

No field of engineering has made greater advances within the past half century than that connected with the regulation and distribution of water. These are shown in the lessening losses from seepage and evaporation, in the lessened cost and increasing durability of structures, and in the inventions and devices for the accurate division and measurement of water. A similar advance has been made with respect to the utilization of water supplied from beneath the earth's surface. Large sums of money are being expended in investigations to determine the extent and location of underground waters. Skilled engineers are constantly making improvements in the methods of boring wells, building tunnels or galleries to intercept underground streams, and in cheapening and simplifying pumps and engines for lifting water to the earth's surface. State experiment stations and the Department of Agriculture are studying how economy in the use of water in irrigation may be promoted, and cities find waste in domestic water supplies a serious evil.

There is nothing in farming where rainfall is ample which corresponds to the intensity of feeling which marks the struggle for control of streams in arid lands, or the anxiety which besets irrigators regarding the stability of their water titles. The farmer who remains serene of spirit when he sees his fields burning for lack of water and knows that his loss of crops is due to wasteful use by others is a rare if not impossible character.

Advancing civilization has done more than augment the uses and value of water; it has increased the evils and dangers arising from water. The ice gorges along the Ohio and Mississippi rivers were a matter of small concern when Indians were the only people concerned. Now they often cost millions of dollars and hazard many lives. Hence immense sums of money are being expended to protect commerce from their action. Every reservoir, every diversion dam in a stream, every artificial waterway adds a new element of danger and insecurity to the lives and property below and gives ground for new laws and regulations with respect to the management of water. The swamps and marshes created through the interruption of underground water sup-

plies by impervious strata are a matter of small concern in sparsely populated regions, but in highly civilized countries they seriously impair the value of lands for agriculture and become a menace to the health and prosperity of cities and towns

ELWOOD MEAD,
Washington, D C
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WATER RIGHTS

DWIGHT S. ANDERSON

A water right may be defined as a proprietary interest in the use of water for the purpose of irrigation or the generation of power, which is enforceable at law. For the purpose of this discussion, this definition will be considered exclusive of all features excepting those pertaining to water for irrigation.

It may be said at the outset that the quality and quantity, so to speak, of a water right is of the last importance to the owner of arid land. Too frequently he is deceived by the quality of his water right, ultimately proving to be inferior to the quality of the water right of another, so that his lands become deprived of that amount of water necessary to cultivation; or by the quantity, so to speak, of his water right supplying him with an inadequate amount. Both frailties come to the same end: deprivation of water and partial or complete ruin to the farmer, but they reach the same end by different means, for few Western streams carry enough water throughout all the season to supply all the land that may be profitably irrigated, and, while it is always true in the early days of a community that there is plenty of water for all, as the years roll by and hundreds of thousands of acres are added to the area over which the stream is made to flow, there comes a conflict between individuals or groups of individuals springing from shortage in the supply, and then it is that the question of the water right becomes vital to the preservation of homes that have perhaps too thoughtlessly been built upon the desert sands.

A water right is usually evidenced by a paper certificate of some sort showing a membership in some co-operative water users' association, or a share of stock therein; or is quite frequently merely a contract between the owner of the land and a company organized to supply water, by which the latter agrees to furnish to the former a certain amount of water each season, on the payment of a certain price for maintenance. The first and the most important thing for the prospective purchaser of land with such a water right to know is not so much the quantity of water to which he is entitled by such certificate or contract, as between himself and the company, but what right that co-operative organization or that water company has to the main supply, as against other and adverse claims which may arise in the future on the part of other persons and companies.

It is quite obvious, in the event that a claimant arises, alleging that his right is superior to yours, or that of the company from whom you hold, that in the event of the water being insufficient to meet the requirements of both, your interests will be in very great peril. It is certain that you will stand in the place of the company, and that your share of water cannot be greater than your proportion of the right of the company or organization from whom you hold, despite any allegations or representations of that company which have been made to you. If the water is not to be obtained, or if a superior right extinguished your right to the water, no amount of warranties to supply a certain amount to you can avail anything except to entitle you to an action at law for your damages. And few, if any, water companies are financed on a basis to enable them to make good to landowners the damages sustained by the deprivation of water, while, in the case of a co-operative company, the situation would likely be that of the landowners suing themselves as an organization for what they, as individuals, have lost.

Therefore the question of the kind and quality of a water right is first a question of fact, and second a question of law. The question of fact should first be determined, and then the question of law.

A water right might be apparently sufficient in law, yet wholly useless because of some matter of fact, and conversely, a water right may be evidenced by no papers of any kind upon which an attorney could pass judgment as to its sufficiency, and yet be perfect. As an example of the former: A certain company, operated for the sale of lands, has purchased thousands of acres of sagebrush land in a section which is so high above the nearest available water that it is apparently beyond the possibility of chance that they can deliver that water to the land in question, yet they have an appropriation from the river which is good and sufficient for the irrigation of all the land owned, provided the one little obstacle of the law of gravitation can be overcome. Another pumping project has plenty of water but no pump, and inasmuch as the lift from the water to the land is a great one, and the company which promoted the project was given to optimism, the land has been sold at $200 an acre to people who, without any question, have a good legal water right, but who, nevertheless, will probably never get water from that company for the reason that it is insolvent.

Again, many ranchers have no water right at all so far as the possession of any contract or stock in a water company is concerned, yet they have plenty of water for all purposes, and doubtless will always have plenty. They own artesian wells, and irrigate their lands by means of them. These wells, constructed at a cost varying from $3,000 to $6,000, have been bored on the land to be watered, and are sufficient for all needs. In that section there has been no failure to find artesian water, I am informed, at any point where the farmer has been sufficiently provided with funds and has prosecuted the work with competent drillers. It must be apparent that such a water right as this is excellent, though evidenced by no writing of any kind, because, as a matter of fact, the water is the private and personal property of the owner of the land, as it comes from the ground, while water running in a natural stream, whether navigable or unnavigable, is not the private and personal property of any person or persons. It is not property in any sense until it has been put to some use. The decisions of the courts on this point are in accord with the idea that running water in a natural stream may be possessed only usufructuarily; that is to say, there may be a right to a use of it in certain persons, but until it has been put to that use it is the property of no man.

From this comes the principle, well known to the law, that a right to water and a right to land are two separate rights. That is to say, the right to running water in a natural stream is not a right like the right of way over a road across or through a neighbor's farm. It is clear that a water right is not a part of the realty in the same sense that a house built upon it is, although the courts generally have held that the right of a riparian owner in streams flowing on or by his land is such a right. By a riparian owner is meant one through whose land, or past whose land, a natural stream runs. Yet, despite these decisions, it is clear that the right is not so "inseparably annexed to the soil" and "part and parcel of it" that the right to water vests in the whole piece of land in such a manner that such land, when cut up and sold to other owners, will carry with it a part of the original riparian right to every parcel, whether bordering on the stream or not. The right to the use of the water exists only so long as it is used by a riparian owner, and it cannot be taken by a riparian owner and conducted to a distance for use on land which does not touch or border upon the stream.

Therefore, in purchasing irrigated land, it should be understood by the buyer that in securing the title to the land itself he does not necessarily secure a water right. He may do so, depending on the facts in the particular case, and, of course, he does so when he buys land upon which is situated a well that provides the water for the land, or through which flows the natural stream that irrigates the land; or if the statute of the state has made

such a provision on the point. But by and in itself, a purchase of land is not a purchase of any right to water for that land, and any right to water which he may get through such purchase will come to him by other means than the mere act of purchase.

It is in consequence of the vagueness of the notions of most persons unfamiliar with irrigation, concerning rights to water, that the author has taken it upon himself to write this series of popular articles upon a subject which has been so well covered by able writers upon the law, that he comes to his subject feeling that any attempt by him to do more than paraphrase what has by them been written would be presumptuous. The purpose of this series is rather to state as clearly as may be possible some of the more obvious points of the law.

Fig. 5. Artesian Well of Mr. H. R. Lince, Pomona, Washington. This well is 400 feet deep. The pressure is 60 pounds per square inch and delivers 2,250 gallons per minute through an 8-inch pipe. The altitude is 1,250 feet. The well irrigates 500 acres 220 feet above the Yakima River.

DEFINITIONS OF "BENEFICIAL" AND "ECONOMICAL" USE OF WATER

Published by the Irrigation Age

Beneficial Use of Water

A water user with a vested right limited to beneficial use is entitled to that amount of water which will render him a reasonable maximum amount of good with a reasonably economic handling of the water. Since he has acquired his vested right from the laws of his state, he is entitled to protection of that right by the state; but it is his duty to the state, and the state has the right to demand of him, that he use every reasonable method to reduce the amount of water required to a minimum. This demand requires the water user to make reasonable preparation of the ground surface for irrigation; to use good judgment in selecting appropriate methods of applying the water to the ground; to prepare reasonably efficient dikes, ditches and structures to get the water over the land in such a way as to reduce the underground losses to a minimum to irrigate the ground with such a head and at such intervals as to require a minimum use of water for proper irrigation; to cultivate the irrigated ground when practicable to prevent undue losses from evaporation; in some cases possibly to govern the character of crops to be grown. It is evident that the reasonable degree of perfection of each of these requirements will vary with the locality and with different and changing conditions in each locality, so that the beneficial use of water is variable.

Economical Use of Water

Since the water supply available for irrigation in the Western states is adequate for only a relatively small percentage of the entire irrigable acreage, the fundamental standard of economical use must be the financial results accomplished per acre-foot of water applied rather than the yield per acre irrigated. It therefore becomes both necessary and desirable to impress irrigators with the fact that in general the largest net profits per acre-foot of water applied are obtained, not from using excessive quantities, but from more careful use of relatively small quantities. In developing a more economical standard for the use of water, it should not be presumed that established rights can be limited to less water than they would carry under the accepted rule of beneficial use; yet by constantly bearing in mind that the ideal ultimately necessary must be the highest net profit per unit of water applied, irrigators may gradually be induced in many instances to obtain for themselves those results, and those undertaking the construction of new projects may be induced to so design

their systems as to provide a liberal water supply during the development period with a view to ultimate development based on economic use.

In the history of irrigation in this country, there has been evident a gradual but very definite evolution in the ideas of what constitutes proper use of water. While the use of water for irrigation was at first a relatively unimportant one, its importance now overshadows all other uses, save that of domestic supply. In the course of this evolution, the doctrine of beneficial use has become established, but in future development this doctrine must in many cases merge into or be supplemented by that of economic use. The doctrine of beneficial use looks to individual interest; that of economic use to the general welfare of society as a whole. So far as possible, water charges, systems of distribution and regulations should be so adjusted as to make the interest of the individual water user coincide with this public interest.

IRRIGATED LAND, PREPARATION OF. See under *Apple Orchard.*

Juneberry

Amelanchier

The Juneberry belongs to a genus of shrubs or small trees of the natural order *Rosaceae* and is native to Europe, Asia and America. There are but few species, but these are so closely related as to be sometimes mistaken for different varieties of the same species. They have alternate leaves, are deciduous and have numerous racemes of white showy flowers appearing early in the spring. The spherical, red or dark purple berries ripen in the summer and are edible. They are ornamental, hardy, succeed in a great variety of soils and climates, and are easily propagated by means of suckers or seeds.

GRANVILLE LOWTHER

Kale, or Broccoli

Kale, or broccoli, is a variety of cauliflower differing from the other in the form and color of its inflorescence and in its hardiness. It succeeds best in loamy soil somewhat hard in texture, but the ground can scarcely be too rich for autumn kale. However, the winter and spring varieties grown on too rich ground are apt to become so succulent and tender that the plants suffer from frost even in sheltered situations, while plants less succulent because grown on poorer soil may all be saved. In the warm climates of the South plants may stand out all winter. Kale requires about the same treatment as cabbage. The plants are used for greens and salads.

Varieties

Tall green curled Scotch.
Dwarf German.
Curled dwarf green Scotch.

For DISEASES AND PESTS OF KALE, see under *Cabbage and Allied Plants.*

Kansas

Kansas is a rolling prairie with occasional bluffs along the streams and plateaus that extend back and beyond them. There are no mountains, no hills and no marshes. The altitude on the east is 750 feet above the sea level and on the west about 4,000 feet. The eastern part of the state is adapted to the growing of corn, wheat, oats, potatoes, vegetables and fruits. The central portion is part of a great wheat belt that begins in Canada in the north and extends southward through Nebraska, Kansas and Oklahoma. The west is a semi-arid region and it is only under the system known as dry farming that wheat, kaffir corn, melons and other products adapted to semi-arid regions have been profitably grown. Alfalfa in later years has been a very profitable crop, especially when grown along the streams where the roots go down to the moist subsoil. The streams of Kansas mostly originate in subterranean sheets of water which come from the Rocky Mountain region and percolate through the vast deposits of sand and gravel with which the soil of Kansas is underlaid.

The soil in the east is a sandy loam mixed with limestone and very fertile. In the central and western portions there is a deposit of sand which within the

memory of persons now living has been mixed with vegetable matter that each year has rotted upon the surface, thus changing the character of the surface soil. The main body of the soil for a great depth was formed as the result of the erosion of the eastern slope of the Rocky mountain range and is coarser on the western border than in the central portion of the state.

The climate is mild, the air clear and pure, the sun hot in July and August but the nights delightfully cool. The winters with few exceptions are not severely cold, although the winds are strong. Sometimes, however, the mercury drops several degrees below zero.

In the eastern part of the state grapes, plums, cherries, currants, raspberries and blackberries grew wild at an early date. In this portion of the state apples, peaches, cherries, grapes and all kinds of orchard fruits do well. There are, however, difficulties for the fruit grower, and among them are the following conditions:

First: On the low lands along the streams, where the roots of the trees strike the sheet water, late spring frosts often injure the bloom, so that while this is an ideal location for the orchard from the standpoint of the growing of trees the probability of injury by frost makes a profitable crop uncertain.

Second: On the hills where there is drainage and freedom from frost there is often not sufficient moisture to develop a commercial crop of apples, pears or peaches that could be sold profitably in the markets in competition with fruits grown in irrigated regions or where there is more rainfall. In the central and eastern portions three or four days of hot winds sometimes injure the fruits so that they can not be sold commercially. These hot winds are becoming less injurious as the country is improved, as alfalfa instead of sand or buffalo grass covers the surface soil and as orchards and groves spring up.

In the extreme western part of the state sugar beets are extensively grown along the streams where water is available for irrigation. Here land which was once considered valueless, or nearly so, is selling for high prices.

According to the census of 1910 the number of bearing fruit trees of all kinds in Kansas was 13,122,464. Of these, apples number 6,929,673; peaches and nectarines, 1,356,438; pears, 292,383; plums and prunes, 624,648; cherries, 661,267; grapes, 2,889,845 vines; small fruits, 5,400 acres; nuts, 143,044 trees.

The counties having the largest number of bearing apple trees are: Atchison, 176,668; Cowley, 189,647; Doniphan, 237,851; Jefferson, 176,787; Leavenworth, 282,403; Lyon, 198,600; Reno, 295,001; Sedgwick, 205,856; Shawnee, 209,152; Washington, 153,044.

GRANVILLE LOWTHER

Production of Various Fruits in Kansas

Small Fruits—1909 and 1899

The following table shows data with regard to small fruits on farms:

CROP	Number of farms reporting 1909	Acres 1909	Acres 1899	Quantity (quarts) 1909	Value 1909
Small Fruits, total	....	5,400	5,824	5,477,274	$454,200
Strawberries	3,967	1,719	2,304	2,119,048	178,094
Blackberries and dewberries	6,912	2,682	2,044	2,535,918	201,134
Raspberries and loganberries	1,678	713	957	616,035	56,446
Currants	829	98	134	67,005	6,023
Gooseberries	1,928	188	212	138,772	12,460
Cranberries	....	....	1	....	....
Other berries	3	(1)	172	496	43

[1]Reported in small fractions.

Blackberries and dewberries are the most important of the small fruits raised in Kansas, with strawberries ranking next. The total acreage of small fruits in 1909 was 5,400 and in 1899, 5,824, a decrease of 7.3 per cent. The production in 1909 was 5,477,000 quarts, as compared with 6,572,000 quarts in 1899, and the value $454,000, as compared with $406,000.

Orchard Fruits, Grapes, Nuts and Tropical Fruits—1909 and 1899

The next table presents data with regard to orchard fruits, grapes, nuts and tropical fruits. The acreage devoted to these products was not ascertained. In comparing one year with the other, the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable, and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

The total quantity of orchard fruits produced in 1909 was 1,448,000 bushels, valued at $945,000. Apples contributed considerably more than nine-tenths of this quantity, cherries ranking next in importance. The production of grapes in 1909 amounted to 6,318,000 pounds, valued at $185,000, and that of nuts to 403,000 pounds, valued at about $8,000. Most of the nuts were black walnuts.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product		
					1909		1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total	....	13,122,464	....	2,273,397	1,447,849	$944,631	3,513,686
Apples	104,920	6,929,673	36,271	1,116,316	1,356,438	807,865	3,214,407
Peaches and nectarines	93,378	4,394,894	25,397	620,709	24,567	23,418	137,489
Pears	46,966	292,383	16,622	132,673	19,412	21,543	21,978
Plums and prunes	42,405	624,648	12,715	126,116	12,250	14,001	57,520
Cherries	65,708	661,267	21,959	237,051	34,409	76,734	60,511
Apricots	29,219	187,381	5,186	28,134	374	512	4,236
Quinces	4,728	28,632	1,364	9,583	361	513	(2)
Mulberries	35	3,586	18	2,815	38	45	(2)
Unclassified	....	....	....	....	....	....	[3]17,545
Grapes	44,311	2,889,845	8,164	343,002	6,317,684	184,673	15,786,019
Nuts, total	....	[4]143,044	....	[4]11,715	[4]402,714	[4]7,625	310,830
Pecans	466	27,716	76	2,797	20,583	1,462	47,530
Black walnuts	1,874	113,537	267	8,619	377,649	6,033	(2)
Chestnuts	14	147	6	19	275	19	(2)
Hickory nuts	29	793	2	6	3,950	107	(2)
Unclassified	....	....	....	....	....	....	[3]263,300
Tropical Fruits (Japanese persimmons)	19	481	1	10	120	48	....

[1] Expressed in bushels for orchard and tropical fruits and pounds for grapes and nuts.
[2] Included with "unclassified."
[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."
[4] Includes almonds, butternuts, filberts, hazelnuts and other nuts.

The production of all orchard fruits together in 1909 was 58.8 per cent less than in 1899, and the production of grapes also declined materially. The total value of orchard fruits declined from $1,729,000 in 1899 to $945,000 in 1909, and that of grapes from $297,000 in 1899 to $185,000 in 1909. It should be noted in this connection that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits, and the like, and may therefore involve some duplication, while the values shown for 1909 relate only to the products in their original condition.

The following table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedule.

PRODUCT	Farms reporting, 1909		Quantity produced		
	Number	Per cent of all farms	Unit	1909	1899
Cider	1,673	0.9	Gals	128,616	491,337
Vinegar	1,116	0.6	Gals	56,620	249,827
Wine and grape juice	801	0.5	Gals	26,625	117,452
Dried fruits	143	0.1	Lbs	5,500	205,820

Frost and Precipitation in Kansas

Station	Frost				Precipitation
	Average Date of		Date of		
	First Killing in Autumn	Last in Spring	First in Autumn	Last in Spring	Annual inches
Colby	Oct. 1	May 3	Sept. 7	May 26	18.7
Concordia	Oct. 14	April 24	Sept. 27	May 19	26.8
Atchison	Oct. 18	April 13	Sept. 29	May 3	37.1
Minneapolis	Oct. 10	May 1	Sept. 19	May 23	24.4
Agricultural Col	Oct. 13	April 23	Sept. 28	May 20	30.5
Topeka	Oct. 13	April 8	Sept. 28	May 19	34.0
Wallace	Sept. 29	April 27	Sept. 7	May 6	15.1
McPherson	Oct. 20	April 19	Sept. 28	May 18	32.1
Lebo	Oct. 20	April 12	Oct. 6	May 2	38.2
Garden City	Oct. 4	May 2	Sept. 7	May 26	19.6
Dodge	Oct. 15	April 17	Sept. 23	May 19	20.3
Mackville	Oct. 3	May 1	Sept. 20	May 26	22.9
Hutchinson	Oct. 15	April 10	Sept. 23	May 3	28.2
Wichita	Oct. 18	April 8	Sept. 23	April 30	30.4
Eureka Ranch	Sept. 30	May 5	Sept. 12	May 26	20.3
Viroqua	Oct. 22	April 17	Sept. 23	May 2	17.6
Eaglewood	Oct. 19	April 13	Sept. 18	May 25	20.6
Independence	Oct. 26	April 11	Oct. 1	May 20	37.1
Columbus	Oct. 25	April 6	Oct. 9	April 13	44.6

Kentucky

Kentucky is 458 miles from east to west and varies from 40 to 171 miles from north to south. The surface is mainly a plateau averaging about 800 feet above the sea, gradually sloping toward the northwest from the Cumberland and Pine mountain ranges in the east, which rise to a height of 2,000 to 3,500 feet. The Cumberland valley is one of the most noted valleys in the eastern states. It is fifteen miles wide, seventy-five miles long and from 1,000 to 1,500 feet above sea level. It is a part of the great blue-grass region underlaid by a limestone formation which extends from east to west across several states. This district was at one time the bed of a vast lake of the lower silurian period on the floor of which were laid several sedementary deposits called upper silurian, devonian, sub-carboniferous and carboniferous, from 3,000 to 5,000 feet deep. The great Appalachian uplift raised this formation some 5,000 feet, the surface forming a dome in the center. Then the process of washing, erosion and disintegration began carrying these materials toward the basins, valleys and plains.

There are about one thousand square miles of deep alluvium soil in the river bottoms of Kentucky. The blue-grass region contains about ten thousand square miles and is self-fertilized by the decomposition of limestone and phos-

phatic shale, so that farms one hundred years old show but little sign of exhaustion. Then there are swamps and barrens where there is insufficient drainage containing about fifteen hundred square miles.

Although the soil of Kentucky is well adapted to horticulture, its climate mild and the physical conditions favorable, yet horticultural industries have not been extensively followed. Since the war there have been developed near Louisville and Cincinnati large orchards and grape vineyards, and apples in various districts. There is a fruit district in Kentucky known as the Muldraugh hill, an elevation of low mountains extending in a southeasterly direction from the Ohio river in Meade county through Hardin, Lane and Greene counties in which apples, peaches, pears and other fruits all reach a high state of perfection. The trees in this district are long-lived and the fruit brings good prices in the markets.

In these regions it is possible to produce high-grade fruit, but statistics do not show that there is the same intelligent progress in fruit-growing as is manifest in the growing of stock. It is true, however, that fruits to which value is added by deep coloring will be grown more successfully, other things being equal, in an arid atmosphere of hot sunshine during the day and of cool nights.

The number of bearing apple trees in Kentucky in 1910 is reported to be 5,538,267; peaches and nectarines, 2,245,402; pears, 337,355; plums and prunes, 355,858; cherries, 212,118; grapes, 605,002 vines; small fruits, 4,387 acres; nuts, 21,339 trees.

The counties producing the largest number of apples are: Breckenridge, 185,570; Greene, 109,439; Hardin, 164,387; Hopkins, 124,278; Jefferson, 109,215; Meade, 261,298; Pulaski, 146,890.

GRANVILLE LOWTHER

Frost and Precipitation in Kentucky

Station	Frost				Precipitation
	Average Date of		Date of		
	First Killing in Autumn	Last in Spring	First in Autumn	Last in Spring	Annual inches
Louisville	Oct. 29	April 6	Sept. 24	May 14	44.5
Shelbyville	Oct. 8	April 14	Sept. 22	May 22	44.3
Lexington	Oct. 25	April 12	Sept. 30	May 20	42.5
Mount Sterling	Oct. 9	April 23	Sept. 21	May 20	46.4
Leitchfield	Oct. 20	April 12	Sept. 30	May 21	48.2
Eubank	Oct. 10	April 25	Sept. 14	May 20	46.8
Paducah	Oct. 27	Mar. 30	Sept. 30	April 13	44.2
Erlington	Oct. 17	April 7	Sept. 30	April 23	48.4
Edmonton	Oct. 11	April 17	Sept. 14	May 22	48.1
Middlesboro	Oct. 13	April 19	Sept. 21	May 21	50.3

KEEPING OUR CHILDREN ON THE FARM. See under *Farms*.

KLIKITAT PETER. See *History of Orcharding in Old Oregon*.

Kohlrabi

The kohlrabi, turnip cabbage, is a variety of cabbage, *Brassica oleracea*, with an edible turnip-shaped stem. Its peculiarity is its swollen stem just above the ground, which is used for the same purpose and grown in the same general way as the turnip. For summer use it is more highly esteemed than the turnip and it may be stored in winter.

The nature and habits of growth are so similar to those of the turnip that they need not be described at length, but it may be said that they will succeed best

Kohlrabi

on new land rich in potash, and that they require substantially the same general treatment as turnips.

There are several varieties, some of them small and used mostly for the table, while others grow to large size and are used for feeding stock.

For Diseases and Pests of Kohlrabi, see under *Cabbage, Turnips and Allied Plants*.

Kumquat

The kumquat is a small tree, *Citrus japonica*, cultivated originally in China and Japan but lately introduced into the United States. The fruit is the color of the orange, is acid in taste and about the size and shape of the plum. The tree is much hardier than most plants of the orange tribe and succeeds well when grafted on the wild species, *Citrus trifoliata*. It is largely used by the Chinese as a sweetmeat preserved in sugar, and is exported in large quantities.

The American Pomological Society recommends the following for cultivation in Florida:

Dessert, Kitchen and Market: Marumi; Nagami.

Lady Apples, Packing Rules. See under *Apple Packing*.

Laws—Horticultural

*CANADIAN INSPECTION AND SALE ACT

Part IX as Amended in 1907-8. (The Fruit Marks Act and Fruit Packages)

1. This act may be cited as the Inspection and Sale Act, R. S., c. 99, s. 1.

Interpretation

319. In this Part, unless the context otherwise requires:

(a) "Closed package" means a box or barrel of which the contents cannot be seen or inspected when such package is closed.

(b) "Fruit" shall not include wild fruit, nor cranberries, whether wild or cultivated.

(c) "Culls" shall include fruit that is either very small for the variety, or immature, or the skin of which is broken so as to expose the tissue beneath, or that is so injured by insects, fungi, abnormal growths, or other causes, as to render it unmerchantable.

The Marking of Fruit

320. Every person who, by himself or through the agency of another person, packs fruit in a closed package, intended for sale, shall cause the package to be marked in a plain and indelible manner

* Dairy and Cold Storage Commissioner's Series, Bulletin No. 11, Department of Agriculture, Ottawa, Canada.

in letters not less than half an inch in length, before it is taken from the premises where it is packed—

(a) with the initials of his christian names, and his full surname and address, or, in the case of a firm or corporation, with the firm or corporate name and address;

(b) with the name of the variety or varieties; and,

(c) with a designation of the grade of fruit, which shall include one of the following four marks, viz.: *Fancy, No. 1, No. 2, No. 3.*

2. Such marks may be accompanied by any other designation of grade or brand, if that designation or brand is not inconsistent with, or marked more conspicuously than, the one of the said four marks which is used on the said package.

321. No person shall sell, offer, expose or have in his possession for sale, any fruit packed,—

(a) in a closed package and intended for sale unless such package is marked as required by the provisions of this Part;

(b) in a closed package, upon which package is marked any designation which represents such fruit as of,—

(i) Fancy quality, unless such fruit consists of well-grown specimens of one variety, sound, of uniform and of at least normal size and of good color for the variety, of normal shape, free from worm holes, bruises, scab and other defects, and properly packed;

(ii) No. 1 quality, unless such fruit includes no culls and consists of well-grown specimens of one variety, sound, of not less than medium size and of good color for the variety, of normal shape and not less than 90 per cent free from scab, worm holes, bruises and other defects, and properly packed;

(iii) No. 2 quality, unless such fruit includes no culls and consists of specimens of not less than nearly medium size for the variety, and not less than 80 per cent free from worm holes and such other defects as cause material waste, and properly packed;

(c) in any package in which the faced or shown surface gives a false representation of the contents of such package; and it shall be considered a false representation when more than 15 per cent of such fruit is substantially smaller in size than, or inferior in grade to, or different in variety from, the faced or shown surface of such package.

Branding Falsely Marked and Falsely Packed

322. Whenever any fruit in any package is found to be so packed that the faced or shown surface gives a false representation of the contents of the package, any inspector charged with the enforcement of this Part may mark the words *Falsely packed* in a plain and indelible manner on the package.

2. Whenever any fruit packed in a closed package is found to be falsely marked, the said inspector may efface such false marks, and mark the words *Falsely marked* in a plain and indelible manner on the package.

3. The inspector shall give notice, by letter or telegram, to the packer whose name is marked on the package, within 24 hours after he marks the words *Falsely packed* or *Falsely marked* on the package.

(Sections 323 and 324 were repealed in 1907-8.)

Fruit Packages

325. All apples packed in Canada for export for sale by the barrel in closed barrels shall be packed in good and strong barrels of seasoned wood having dimensions not less than the following, namely: 26¼ inches between the heads, inside measure, and a head diameter of 17 inches, and a middle diameter of 18½ inches, representing as nearly as possible 96 quarts.

2. When apples, pears or quinces are sold by the barrel, as a measure of capacity, such barrel shall not be of lesser dimensions than those specified in this section.

3. When apples are packed in Canada for export for sale by the box, they shall be packed in good and strong boxes of seasoned wood, the inside dimensions of which shall not be less than 10 inches

in depth, 11 inches in width and 20 inches in length, representing as nearly as possible 2,200 cubic inches.

4. When apples are packed in boxes or barrels having trays or fillers wherein it is intended to have a separate compartment for each apple, the provisions of this section as to boxes and barrels shall not apply.

Berries, Etc.

326. Every box of berries or currants offered for sale, and every berry box manufactured and offered for sale, in Canada, shall be plainly marked on the side of the box, in black letters at least half an inch square, with the word "Short," unless it contains when level-full as nearly exactly as practicable,—

(a) at least four-fifths of a quart; or,

(b) two-fifths of a quart.

(2) Every basket of fruit offered for sale in Canada, unless stamped on the side plainly in black letters, at least three-quarters of an inch deep and wide, with the word "Quart" in full, preceded with the minimum number of quarts, omitting fractions, which the basket will hold when level-full, shall contain, when level-full, one or other of the following quantities:

(a) Fifteen quarts or more.

(b) Eleven quarts, and be 5¾ inches deep perpendicularly, 18¾ inches in length and 8 inches in width at the top of the basket, 16¾ inches in length and 6⅞ inches in width at the bottom of the basket, as nearly exactly as practicable, all measurements to be inside of the veneer proper and not to include the top band.

(c) Six quarts, and be 4½ inches deep perpendicularly, 15⅝ inches in length and 7 inches in width at the top of the basket, 13½ inches in length and 5⅞ inches in width at the bottom of the basket, as nearly exactly as practicable, all measurements to be inside of the veneer proper and not to include the top band: *Provided*, That the Governor in Council may, by proclamation, exempt any province from the operation of this section.

(d) Two and two-fifths quarts, as nearly exactly as practicable.

Inspector's Right to Examine

327. Any person charged with the enforcement of this Part may enter upon any premises to make examination of any packages of fruit suspected of being falsely marked or packed in violation of any of the provisions of this Part, whether such packages are on the premises of the owner, or on other premises, or in the possession of a railway or steamship company.

Offences and Penalties

328. Every person who, by himself or through the agency of any other person, violates any of the provisions of sections 320 and 321 of this Act, shall be liable, for the first offence, to a fine not exceeding $25 and not less than $10; for the second offence, to a fine not exceeding $50 and not less than $25; and for the third and each subsequent offence, to a fine not exceeding $200 and not less than $50, together, in all cases, with the costs of prosecution; and in default of payment of such fine and costs shall be liable to imprisonment, with or without hard labor, for a term not exceeding one month, unless such fine and costs, and the costs of enforcing them, are sooner paid.

2. Whenever any such violation is with respect to a lot or shipment consisting of 50 or more closed packages, there may be imposed, in addition to any penalty provided by this section, for the first offence, 25 cents; for the second offence, 50 cents; and for the third and each subsequent offence, $1, for each closed package in excess of 50 with respect to which such violation is committed.

329. Every person who, not being an inspector, wilfully alters, effaces, or obliterates, wholly or partially, or causes to be altered, effaced, or obliterated, any marks on any package which has undergone inspection, shall incur a penalty of $100 for the first offence, and $200 for the second and each subsequent offence, together, in all cases, with the costs of prosecution; and in default of payment of such fine and costs shall be liable to imprisonment, with or without hard labor, for a term not exceeding one month, un-

less such fine and costs, and the costs of enforcing them, are sooner paid.

330. Every person who violates any of the provisions of sections 325 and 326 of this Act shall be liable, on summary conviction, to a penalty of 25 cents for each barrel of apples, or box of apples, pears, quinces, berries, or currants, or basket of fruit, or berry box, respecting which such violation is committed, together with the costs of prosecution; and in default of payment of such fine and costs shall be liable to imprisonment, with or without hard labor, for a term not exceeding one month, unless such fine and costs, and the costs of enforcing them, are sooner paid.

(Section 331 was repealed in 1907-08.)

332. Every person who obstructs any person charged with the enforcement of this Part in entering any premises to make examination of packages of fruit as provided by this Part, or who refuses to permit the making of any such examination, shall be liable to a penalty not exceeding $500 and not less than $25, together with the costs of prosecution, and in default of payment of such penalty and costs, shall be liable to imprisonment, with or without hard labor, for a term not exceeding six months, unless such penalty and costs, and the costs of enforcing the same, are sooner paid.

333. The person on whose behalf any fruit is packed, sold, offered or had in possession for sale, contrary to the provisions of the foregoing sections of this Part, shall be *prima facie* liable for the violation of this Part.

333a. The Minister of Agriculture may make appointments of inspectors and other persons for the enforcement of this Part.

333b. The Governor in Council may make any such regulations as he considers necessary in order to secure the efficient enforcement and operation of this Part, and may by such regulations provide for the imposition of penalties not exceeding $30 on any person offending against them; and the regulations so made shall be in force from the date of their publication in *The Canada Gazette*, or from such other date as is specified in the proclamation in that behalf; and the violation of any such regulation shall be deemed an offence against this Part, and punishable as such.

Procedure

334. For the purposes of jurisdiction under Part XV of the Criminal Code, in any complaint, information or conviction for a violation of any of the provisions of this Part, the matter complained of may be alleged and shall be held to have arisen at the place where the fruit was packed, sold, offered, exposed or had in possession for sale.

335. No appeal shall lie from a conviction under this Part except to a superior, county, circuit or district court, or the court of the sessions of the peace, having jurisdiction where the conviction was had; and such appeal shall be brought, notice of appeal in writing given, recognizance entered into or deposit made, within 10 days after the date of conviction.

2. The trial on any such appeal shall be heard, had, adjudicated upon and decided, without the intervention of a jury, at such time and place as the court or judge hearing the trial appoints, and within 30 days from the date of conviction, unless the said court or judge extends the time for hearing and decision beyond such 30 days.

3. In all respects not provided for in this Part, the procedure under Part XV of the Criminal Code shall, so far as applicable, apply to all prosecutions brought under this part.

Application of Fines

336. Any pecuniary penalty imposed under this Part shall, when recovered, be payable one-half to the informant or complainant and the other half to His Majesty.

Order in Council of September 14, 1901

PRIVY COUNCIL, CANADA.

AT THE GOVERNMENT HOUSE AT OTTAWA,
The 14th day of September, 1901.

PRESENT:

His Excellency the Governor General in Council.

Whereas by section 16 of the Act, 1 Edward VII, chapter 27, intituled, "An

Act to provide for the marking and inspection of packages containing fruit for sale," it is provided as follows:

"16. The Governor in Council may make such regulations as he considers necessary in order to secure the efficient enforcement and operation of this Act; and may by such regulations impose penalties not exceeding $50 on any person offending against them; and the regulations so made shall be in force from the date of their publication in the *Canada Gazette*, or from such other date as is specified in the proclamation in that behalf; and the violation of any such regulation shall be deemed an offence against this Act, and punishable as such."

Therefore His Excellency the Governor General in Council is pleased, in virtue of the above cited provisions of the said Act, to make the following regulations, the same to come into force on the date of their publication in *The Canada Gazette*.

1. The Minister of Agriculture may make appointments of inspectors and other persons for the enforcement of the Act.

2. Any inspector charged with the enforcement of the Act may detain, for the time necessary to complete his inspection, any shipment of fruit, in respect of which he has reasonable grounds for believing that the marking of the package, or the packing of the fruit, constitutes a violation of the Act; such fruit shall at all times be at the risk and charges of the owner thereof; and any inspector detaining fruit shall give the owner, where ascertained, notice that such fruit is being detained. in storage or otherwise, as the case may be.

3. The despatch of a prepaid telegram or letter to the packer whose name is marked on the package shall be considered due notice.

4. No person shall for himself or on behalf of any other person, pack any fruit for sale, contrary to the provisions of the Act.

5. Any inspector or other person who violates any of the regulations made under the authority of the Act shall for each offence, on summary conviction, be liable to a fine of not less than $5 and not exceeding $50, together with the costs of prosecution.

JOHN J. MCGEE,
Clerk of the Privy Council.

GENERAL NOTES

(a) For Inspectors

Inspectors will not examine particular lots of fruit at the request of buyers or sellers. When not under specific directions, inspectors will use their discretion as to where they can best employ their time within the district assigned them.

Inspectors will avoid anything which would delay unnecessarily the movement of fruit or which would interfere with the interests of those concerned in the fruit trade, except in so far as action may be necessary to prevent violation of the Act.

Packages which have been inspected are to be closed by the inspector and left in marketable order after examination, unless the owner prefers to take charge of such opened packages.

(b) For the Grower

If the grower sells his fruit unpacked, the Act does not apply to him in any particular.

If he sells his fruit in uncovered barrels or boxes, the Act requires only that the top of each package shall be no better than the fruit throughout the package.

If the grower packs his own fruit he accepts the responsibility of the packing, as described in the following paragraph:

(c) For the Packer (the Owner at the Time of Packing)

Section 320 of the Act requires that the person who owns the fruit when it is packed in closed barrels or boxes must mark plainly on each package:

1. His name and postoffice address.
2. The name of the variety of the fruit.
3. The grade of the fruit, whether it is "Fancy," "No. 1," "No. 2," or "No. 3."

If he marks the package "Fancy," the fruit must be practically perfect, as described in section 321 (b), (i).

On reading subsections (b), (ii) carefully, it will be seen that the packer should aim in packing grade No. 1 to discard every injured or defective fruit, and not to deliberately include 10 per cent of inferior specimens. This margin is meant to make the work of grading easier and more rapid than if absolute perfection were exacted. Ten per cent is presumed to be the margin within which an honest packer can do rapid work, using every endeavor to make each specimen conform to the general standard for the grade.

Even the 20 per cent margin in grade No. 2 must be composed of specimens not less than nearly medium size, including no culls.

The Act makes no restriction as to the quality of fruit which is marked "No. 3."

The owner at the time of packing is responsible if the face of each package does not represent the contents as required by section 321, subsection (c). Over-facing is an offense against the Act, which is most severely dealt with by the courts.

(d) For the Foreman of the Packing Gang

Whether he is putting up his own fruit or that of another person, the man who does the packing is required, by section 4 of the Order in Council printed above, to pack the fruit in accordance with the law. He should read the whole Act carefully, but should give section 321 special attention. If he violates these requirements, he is liable to the fine specified in section 5 of the Order in Council.

(e) For the Apple Operator

The apple operator for his own protection should see that his workmen are familiar with the Inspection and Sale Act, Part IX.

Section 4 of the Order in Council is a special protection for the apple operator against carlessness or fraudulent work upon the part of his packers.

Where the apple operator buys apples already packed, he should note particularly that the fruit is marked as required by section 320.

To avoid possible complications in case of fraudulent packing, all contracts should stipulate clearly whether the apples are purchased packed in barrels or whether they are purchased to be packed by the buyer.

Apples should not be bought or sold with the stipulation, "subject to government inspection." There is no such thing as "government inspection," meaning a "certificate" or "report" guaranteeing the quality of a particular lot of fruit.

HORTICULTURAL LAWS OF OREGON

(From Lord's Oregon Laws)

The State Board of Horticulture

Section 5470. *Board of Horticulture Constituted.*

There is hereby created a board of horticulture, to consist of six members, who shall be appointed by a board consisting of the Governor, Secretary of State and State Treasurer. One member of the said board of horticulture shall represent the state at large and shall be the president and executive officer of the board and one member shall be appointed to represent each of the five districts as hereby created, to-wit: (1) The first district which shall comprise the counties of Multnomah, Clackamas, Yamhill, Washington, Columbia, Clatsop and Tillamook; (2) The second district which shall comprise the counties of Marion, Polk, Benton, Lincoln, Linn and Lane; (3) The third district which shall comprise the counties of Douglas, Jackson, Klamath, Josephine, Coos, Curry and Lake; (4) The fourth district which shall comprise the counties of Wasco, Sherman, Morrow, Gilliam and Crook; (5) the fifth district which shall comprise the counties of Umatilla, Union, Wallowa, Baker, Malheur, Harney and Grant. (L. 1889, p. 126, Sec. 1; L. 1891, p. 174, Sec. 1; L. 1895, p. 33, Sec. 1; L. 1899, p. 55, Sec. 1; B. & C., Sec. 4176.)

Section 5471. *Residence of Members—Terms of Office—Duties of President.*

The members shall reside in the districts for which they are respectively ap-

pointed. They shall be selected with reference to their knowledge of the practical experience in horticulture and the industries connected therewith, and shall be engaged in practical horticulture during their incumbency of the office of commissioner. They shall hold office for the term of four years, and until their successors are appointed and have qualified, unless removed by the appointing board for failure to perform their duties. It shall be the duty of the president to visit, at least once a year, every district and examine the orchards, nurseries and work of the district commissioners, and ascertain whether or not the law and regulations of the board are being properly executed. He must personally inspect most of the orchards during the fruit-growing season, see that the regulations of the board regarding spraying are being faithfully executed wherever insects, pests, or diseases injurious to trees or fruit are to be found. He must visit the principal fruit shipping points during the shipping season, inspect the fruit shipped and prevent the shipment of insect and pest-infected fruit. He shall give notice through the public press one week in advance of his visit to each county, giving the time and place of his visit, where he shall receive complaints of fruit growers and distribute to them printed and oral instructions regarding destruction of pests and other information, including proper methods of handling, packing and shipping fruits. It shall also be his duty to visit, when possible, if requested by an association of a number of fruit growers, the meetings of such associations of fruit growers and aid them in the organization of proper associations beneficial to the growing and marketing of fruits. The president shall preside at all the meetings of the board, and may call special meetings whenever an emergency may require it. He shall make an annual report to the appointing board of the general condition of the fruit interests of the state and success of the commissioners in the work of exterminating pests and executing the law. (L. 1889, p. 126, Sec. 2; L. 1895, p. 34, Sec 2; L. 1899, p. 56, Sec. 2; B. & C., Sec. 4177.)

Section 5472. *Secretary of Board, His Salary—Treasurer—Oath of Members.*

Said board shall employ without their number a secretary, who shall exercise the powers and discharge the duties conferred upon him by this act, and whose compensation shall not exceed $100 per month, to be paid in the same manner as other state officers. Said board shall also elect from their own number a treasurer. Before entering upon the discharge of his duties each member of the board shall make and subscribe an oath to support the Constitution of the United States and of the State of Oregon, and to diligently, faithfully and impartially discharge the duties of his office, which said oaths shall be filed with the secretary. The secretary shall make and subscribe a like oath, which shall be filed with the treasurer of the board. (L. 1899, p. 127, Sec. 3; L. 1895, p. 34, Sec. 3; B. & C, Sec. 4178; L. 1905, c. 222, p. 385, Sec. 6.)

Section 5473. *Each Member May Appoint Deputies—Their Authority.*

Each member of the State Board of Horticulture shall have authority to appoint, whenever it shall seem to him expedient, a special deputy or deputies who shall be empowered to discharge any and all the duties prescribed for the members of said board in Section 5487, but the work and authority of said deputies shall be confined to the districts of the commissioners by whom they are respectively appointed. (L. 1903, p. 251, Sec. 1.)

Section 5474. *Compensation of Deputies.*

Any deputy appointed under the authority conferred by this act shall receive as compensation for his services $2.00 per day for each day actually spent in the performance of his duties as such deputy, and all claims for compensation of such deputies shall be audited and paid in the same manner as claims of members of the board of horticulture. (L. 1903, p. 251, Sec. 2.)

Section 5475. *Expense, How Paid.*

Any expense incurred under the provisions of Section 5474 of this act shall be paid out of the appropriation allowed to the State Board of Horticulture. (L. 1903, p. 251, Sec. 3.)

Section 5476. *Board May Receive Donations, etc., and Select Lecturers, Meetings of.*

The board may receive, manage, use and hold donations and bequests of money and property for promoting the objects of its formation. It shall meet on the second Monday of April and October in each year, and as much oftener as it may deem expedient, for consultation on and for the adoption of those measures that will best promote the horticultural industries of the state It may, but without expense to the state, select and appoint competent and qualified persons to lecture in each of the districts named in Section 5470, for the purpose of encouraging and improving practical horticulture and of imparting instruction in the best methods of treating the diseases of fruits and fruit trees, cleansing orchards, and exterminating orchard pests. (L. 1889, p. 127, Sec. 4; B & C., Sec. 4179.)

Section 5477. *Office of Board, Where Held, When Open.*

The office of the board shall be located at such a place as a majority thereof may determine. It shall be kept open to the public, subject to the rules of the board, every day excepting Sunday and legal holidays, and shall be in charge of the secretary during the absence of the board. (L. 1889, p. 127, Sec. 5; B. & C. Sec. 4180.)

Section 5478. *Board May Make Quarantine Regulations—Violation a Misdemeanor.*

For the purpose of preventing the introduction into the state or spread of contagious diseases, insects, pests, or fungus growths among fruit or fruit trees, and for the prevention, treatment, cure and extirpation of fruit pests, and diseases of fruit and fruit trees, and for the disinfection of grafts, scions, orchard debris, fruit boxes and packages, and other material or transportable articles dangerous to orchards, fruit or fruit trees, said board may make regulations for the quarantining, inspection, and disinfection thereof, which said regulations shall be circulated by the board in printed form among the fruit growers and fruit dealers of the state; shall be published at least four successive times in some daily or weekly paper in each county in the state before the same shall be in force therein, and shall be posted in three conspicuous places in each county in the state, one of which shall be at the county court house. Such regulations, when so promulgated, shall be held to impart notice of their contents to all persons within the state, and shall be binding upon all persons therein. A willful violation of any quarantine or other regulation of said board, necessary to prevent the introduction into the state, or the shipment, sale or distribution of any articles so infected as to be dangerous to the fruit-growing interest of the state, or the spread of dangerous diseases among fruit trees or orchards, shall be deemed a misdemeanor, and on conviction thereof shall be punished by a fine of not less than $5 nor more than $100 for each offense, or by fine and imprisonment not less than five nor more than thirty days. (L. 1889, p. 127, Sec. 6; L. 1891, p. 175, Sec. 6; L. 1895, p. 34, Sec. 4; B. & C. Sec. 4181.)

Section 5479. *Members to Visit Districts, Inspect and Quarantine Orchards.*

It shall be the duty of the several members of the board, and of the secretary under their direction, to visit their respective districts, and to see that all regulations of the board and all provisions of law to prevent the introduction or spread of fruit pests and diseases of trees or plants injurious to the horticultural interests of the state are enforced. Any member of the board, or the secretary thereof, shall forthwith, upon the complaint of interested parties, inspect orchards, nurseries, and other places suspected to be infested with fruit pests or infected with contagious diseases injurious to trees, plants or fruits. If, upon report of any member or the secretary, the board shall be of opinion that any

locality, district, orchard or place is infested with fruit pests or infected with contagious diseases injurious to trees, plants or fruits, and liable to spread to other orchards or localities to their damage or injury so as to be a public danger, said board shall, by an order entered upon its minutes, declare such place to be under quarantine, and shall give notice thereof by posting a notice in writing in a conspicuous place upon the premises, specifying with convenient certainty what place or premises are under quarantine regulations, and by delivering a copy of such notice to the owner or person in charge of the premises, if he may be found thereon; and such place shall thereafter be subject to quarantine regulations of the board, and violation thereof shall be punishable as hereinbefore provided. As soon as, in the opinion of any member of the board, or the secretary thereof, the danger from such quarantine locality shall have ceased, he may suspend the said quarantine, and shall immediately report the fact to the board, who may confirm such action or may re-establish the said quarantine, in which case it shall not be again suspended but by action of the board. (L. 1889, p. 128, Sec. 7; L. 1895, p. 35, Sec. 5; B. & C. Sec. 4182.)

Section 5480. *May Appoint Quarantine Guardians, Fix Salaries, Report Violations of Law.*

The board, and, in case of necessity during the recess of the board, the member residing in the quarantined district, or the secretary may appoint such quarantine guardians as may be needed to carry out the provisions of this act, whose duty it shall be to see that the regulations of the board and the instructions of the secretary are enforced and carried out. They shall also report to the board all infractions or violations of said regulations or of the law in regard to quarantining, disinfection and destruction of pests. The salary of quarantine guardians shall be fixed by the board at not to exceed $2.00 per day, and shall be paid by the owners of orchards or other places under quarantine, and they may maintain an action therefor before any justice of the peace in any district in which any quarantined locality is wholly or in part located; but in no case shall they have any claim upon the state for such services. (L. 1889, p. 128, Sec. 8; L. 1891, p. 176, Sec. 2; L. 1895, p. 36, Sec. 6; B. & C. Sec. 4183.)

Section 5481. *Authority Conferred in Last Two Sections, Exercised in Emergencies.*

The powers conferred in the two preceding sections of this act shall be exercised only in great and imminent danger to the fruit interests of the state, and with the utmost caution and regard for the rights of individuals affected, consistent with the safety and welfare of the fruit interest of the whole state. (L. 1895, p. 36, Sec. 7; B. & C. Sec. 4184.)

Section 5482. *County Inspector, When County Court May Appoint—Qualifications.*

Upon a petition of not less than twenty-five residents and fruit growers of any county in this state, the county court of said county shall appoint a county inspector, whose duty it shall be to inspect the apple and other fruit orchards of said county, and to enforce the laws now in force and that may be hereafter in force in this state, applicable to the fruit industry and to the growing, handling and selling of fruit, fruit trees and other nursery stock; *Provided*, That the inspector so to be appointed shall be recommended and certified to be competent for such position by the state district commissioner of the State Board of Horticulture for the said county, and said county inspector shall hold his office during the pleasure of said county court. (L. 1905, c. 222, p. 383, Sec. 1.)

Section 5483. *District Commissioners to Instruct and Supervise County Inspectors.*

It shall be the duty of the state district commissioner to instruct and educate the county inspectors as to the laws and quarantine regulations of this state, and the rules and regulations of the State Board of Horticulture. The county inspector shall perform his duties under the general supervision of the state district com-

missioner for said county, to whom he shall make reports in the manner prescribed by the State Board of Horticulture. (L. 1905, c. 222, p. 384, Sec. 2.)

Section 5484. *Compensation of County Inspector, Report of Time and Expenses.*

Such county inspector shall be paid for his services by the said county, a sum not exceeding $3.00 per day, and shall be reimbursed for his actual outlay for team hire and railway fares for each and every day actually employed in the performance of his duties as herein provided, and the said county inspector shall report monthly to the said state district commissioner the time for which he is entitled to pay during the month next preceding, and also a statement of his own personal expenses while engaged in the performance of his duty as such county inspector during said month, and shall also file vouchers showing expenditures for such personal expenses, and the said state district commissioner shall certify the same to the county court before such compensation and personal expenses shall be paid to said county inspector. (L. 1905, c. 222, p. 384, Sec. 3; L. 1907, c. 58, p. 109, Sec. 3.)

Section 5485. *Inspector of Adjacent County May Perform Duties When County Fails to Appoint.*

If any county for any reason fails to appoint a county inspector as herein provided, then the inspector of any adjacent county may perform such services, and his compensation and the necessary expenses incurred in the performance of his duty shall be charged against the county where the service is performed, as if he had been appointed by the county court of said county. (L. 1905, c. 222, p. 384, Sec. 4.)

Section 5486. *Appeals From County Inspectors to District Commissioner.*

The state district commissioner of horticulture shall hear and promptly decide all appeals from the county inspectors in his district, and his decision shall have full force and effect until set aside by the courts of the state. All appeals from county inspectors to the district commissioners shall be under the form and regulations as prescribed by the State Board of Horticulture. (L. 1905, c. 222, p. 384, Sec. 5.)

Section 5487. *Infested Trees Nuisance —Proceedings Relating Thereto—Authority to Abate.*

It shall be the duty of the several members of the board and of the secretary or the county inspectors under their direction, whenever they shall deem it necessary, to cause an inspection to be made of any orchards, nurseries, trees, plants, vegetables, vines, or any fruit packing house, storeroom, salesroom, or any other place within their district, and also of any fruit trees or nursery stock shipped from beyond the limits of this state, and if found infected with any pests, diseases or fungous growth injurious to fruits, plants, trees, vegetables, or vines, or with their eggs or larvae liable to spread to other places or localities, or of such nature as to be a public danger, they shall notify the owner or owners or persons in charge of or in possession of such articles, things or places, that the same are so infested; or in case such fruit trees or nursery stock, although apparently sound and not infested by any pest, shall have been from an infested district beyond the limits of this state, they shall also so notify the owner or owners or persons in charge of or in possession of the same, and shall require said persons to eradicate or destroy said insects or pests or their eggs or larvae, or such imported fruit trees or nursery stock of infested districts without the limits of the state, or to treat such contagious diseases within a certain time to be specified in said notice. Said notice may be served upon the person or persons, or any of them, owning, having charge or having possession of such infested place, article, or thing, by any member of the board, or by the secretary thereof, or by any person deputed by said board for that purpose, or they may be served in the same manner as a summons in an action at law. Such notice shall contain directions for the application of some treatment approved by the commissioners for the eradication or de-

struction of said pests, or the eggs or larvae thereof, or the treatment of contagious diseases or fungous growths. Any and all such places, orchards, nurseries, trees, plants, shrubs, vegetables, vines, fruit or articles thus infested are hereby declared to be a public nuisance; and whenever any such nuisance shall exist at any place in the state on the property of any owner or owners upon whom or upon the person in charge or possession of whose property notice has been served as aforesaid, and who shall have failed or refused to abate the same within the time specified in such notice, or in the property of any non-resident or any property not in the possession of any person and the owner or owners of which cannot be found by the resident members of the board or the secretary or county inspector after diligent search within the district, it shall be the duty of the board or the member thereof in whose district the nuisance shall exist, or the secretary or county inspector under his or their directions, to cause such nuisance to be at once abated by eradicating or destroying said insects or pests or their eggs or larvae, or by treating or disinfecting or destroying the infested or diseased articles, or imported fruit trees or nursery stock imported from an infested district without the limits of this state. The expense thereof shall be a county charge and the county court shall allow and pay the same out of the general fund of the county. Any and all sums so paid shall be and become a lien on the property and premises from which said nuisance shall have been removed or abated, in pursuance of this act, and may be recovered by a suit in equity against such property or premises, which suit to foreclose such liens shall be brought in the circuit court of the county where the premises are situate, by the district attorney in the name and for the benefit of the county making such payment or payments. The proceedings in such cases shall be governed by the same rules, as far as may be applicable, as suits to foreclose mechanics' liens, and the property shall be sold under the order of the court and the proceeds applied in like manner. The board is hereby invested with the power to cause such nuisances to be abated in a summary manner. (L. 1895, p. 37, Sec. 8; B. & C.. Sec. 4186; L. 1907, c. 58, p. 110, Sec. 2.)

Section 5488. *Duties of Secretary.*

It shall be the duty of the secretary to attend all meetings of the board, and to preserve records of the proceedings, correspondence, and actions of the board; to collect books, pamphlets, periodicals, and other documents containing valuable information relating to horticulture, and to preserve the same; to collect statistics and general information showing the actual condition and progress of horticulture in this state and elsewhere; to correspond with agricultural and horticultural societies, colleges, and schools of agriculture and horticulture, and such other persons and bodies as may be directed by the board, and prepare as required by the board reports for publication. (L. 1889, p. 129, Sec. 9; L. 1895, p. 38, Sec. 9; B. & C., Sec. 4186.)

Section 5489. *Biennial Report—Compensation of Board Members.*

The board shall biennially, in the month of January, report to the legislative assembly a statement of its doings, with a copy of the treasurer's reports for the two years preceding the session thereof. The members shall receive as compensation their actual expenses while engaged upon the work of the board or the enforcement of the provisions of this act, and shall be allowed $3.00 a day for the time actually employed. (L. 1889, p. 129, Sec. 11; L. 1895, p. 38, Sec. 11; B. & C., Sec. 4187.)

Section 5490. *Duties of Treasurer.*

The treasurer shall receive all moneys belonging to the board, and pay out the same only for bills approved by it, and shall render annually to the board a statement in detail of all receipts and disbursements. (L. 1889, p. 129, Sec 12; L. 1895, p. 39, Sec. 12; B. & C., Sec. 4188.)

Section 5491. *Board to Report to Legislature.*

The said board shall report to the legislative assembly, commencing in January, 1891, what, if any, legislation is needed in aid of the horticultural and fruit-growing interests of the state. (L. 1889, p. 130, Sec. 14; B. & C., Sec. 4189.)

Section 5495. *All Prunings and Cuttings Required to be Burned.*

It shall hereafter be unlawful for any person, firm, or corporation owning or operating any nursery, fruit orchard of any kind, hopyards, flower gardens, or ornamental trees to throw any cuttings or prunings from any fruit trees, nursery stock, ornamental trees, or hop vines into any public road, highway, lane, field, or other inclosure, or into any water course of any kind; but shall destroy such cuttings or prunings with fire within 30 days from the time such cuttings or prunings are made. (L. 1899, p. 97, Sec. 1; B. & C., Sec. 4190.)

Section 5496. *Owners of Nurseries, Etc., Required to Spray.*

It shall hereafter be the duty of any person, firm, or corporation owning or operating any such nursery, fruit orchard, hopyard, flower garden, or ornamental trees, and knowing such to be infected with any kind of insects, pests, or disease, to immediately spray or destroy the same in such manner as the fruit commissioner for his district may direct. (L. 1899, p. 97, Sec. 2; B. & C., Sec. 4191.)

Section 5497. *Certificate of Purity to Go with Packages of Spraying Material.*

It shall be unlawful for any person, firm, or corporation doing business in the state of Oregon to sell Paris green, arsenic, London purple, sulphur, or any spray material or compound for spraying purposes, in quantities exceeding one pound, without providing with each package sold a certificate, duly signed by the seller thereof, guaranteeing the quality and per cent of purity of said materials. (L. 1899, p. 98, Sec. 3; B. & C., Sec. 4192.)

Section 5489. *Penalty Where Material Does Not Conform to Certificate.*

Any person, firm, or corporation selling any of the above materials which do not conform with the certificate furnished therewith shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be subject to a fine of not less than $25 nor more than $100. (L. 1899, p. 98, Sec. 4; B. & C., Sec. 4193.)

Section 5499. *Unlawful to Import or Sell Infested Fruit.*

It shall be unlawful for any person, firm, or corporation to import or sell any infested or diseased fruit of any kind in the state of Oregon. (L. 1899, p. 98, Sec. 5; B. & C., Sec. 4194.)

Section 5500. *Packing, etc., or Delivering for Shipment Infected Fruit, etc., a Misdemeanor.*

Every person who packs or prepares for shipment to any point within the state, or who delivers or causes to be delivered to any express agent or railroad agent, or other person, or to any transportation company or corporation, for shipment to any point without the state, any fruit or fruits, either fresh, cured or dried, that is infected with insect pests or diseases injurious to trees, shrubs, plants, fruits, or vegetables, is guilty of a misdemeanor. (L. 1899, p. 98, Sec. 6; B. & C., Sec. 4195.)

Section 5501. *Penalty for Violating Provisions of Act.*

Any person, firm, or corporation violating any of the provisions of this act shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine of not less than $25 nor more than $100. (L. 1899, p. 98, Sec. 7; B. & C., Sec. 4196.)

Section 5502. *Commissioner of Horticulture to Present Evidence, and District Attorney to Prosecute.*

It shall be the duty of the Commissioner of the State Board of Horticulture of the district in which a violation of this act occurs to present the evidence of the case to the district attorney, whose duty it shall be to prosecute any person guilty of a violation of this act, which prosecution may be brought in any of the justice courts of this state. (L. 1899, p. 98, Sec 8; B. & C., Sec. 4197.)

(d) Of Packing and Labeling Fruit and Nursery Stock

Section 5503. *Green Fruit Packed for Market to Be Labeled.*

Any person, firm, association or corporation engaged in growing, selling or packing green fruits of any kind within the state of Oregon, shall be required, upon packing any such fruit for market, whether intended for sale within or without the state of Oregon, to stamp, mark, or label plainly on the outside of every box or package of green fruit so packed, the name and postoffice address of the person, firm, association or corporation packing the same: *Provided further*, That when the grower of such fruit be other than the packer of the same, the name and postoffice address of such grower shall also prominently appear upon such box or package as the grower of such fruit. (L. 1907, c. 11, p. 22, Sec. 1.)

Section 5504. *False Representation as to Place of Raising or Packing Fruit Forbidden.*

It shall be unlawful for any dealer, commission merchant, shipper or vendor, by means of any false representations whatever, either verbal, printed or written, to represent or pretend that any fruits mentioned in Section 5503 were raised, produced or packed by any person or corporation, or in any locality other than by the person or corporation, or in the locality where the same were in fact raised, produced or packed, as the case may be. (L. 1907, c. 11, p. 22, Sec. 2.)

Section 5505. *Possession of Fruit Falsely Labeled—Evidence.*

If any dealer, commission merchant, shipper, vendor, or other person, shall have in his possession any of such fruits so falsely marked or labeled contrary to the provisions of Section 5503, the possession by such dealer, commission merchant, shipper, vendor, or other person, of any such fruits so falsely marked or labeled shall be *prima facie* evidence that such dealer, commission merchant, shipper, vendor, or other person, has so falsely marked or labeled such fruits. (L. 1907, c. 11, p. 22, Sec. 3.)

Section 5506. *Penalty for Violation of Act.*

Any person violating any of the provisions of this act shall be deemed guilty of a misdemeanor, and, upon conviction thereof, shall be punished by a fine of not less than $5, nor more than $500, or by imprisonment in the county jail not less than 10 nor more than 100 days, or by both such fine and imprisonment, at the discretion of the court. (L. 1907, c. 11, p. 22, Sec. 4.)

Section 5507. *Liability for False Representation as to Variety of Nursery Stock.*

Any person selling nursery stock, or young trees, and representing the same to be of a variety different from what said nursery stock of trees actually are, shall be required to replace all such trees with stock of the same grade and variety as the original order, and shall be required to make reasonable compensation to the purchaser for expenses and loss of time due to such error having been made. (L. 1907, c. 57, Sec. 109.)

HORTICULTURAL LAWS OF THE STATE OF WASHINGTON, 1913

Chapter VIII

Powers and Duties of Commissioner—(c) Vice the State Commissioner of Horticulture

Location of Office

Section 127. That section 3072 of Remington & Ballinger's Annotated Codes and Statutes of Washington be, and the same is hereby amended to read as follows: Sec. 3072. The State Commissioner of Horticulture shall maintain an office at Tacoma, Washington, which office shall be kept open from 9 o'clock a. m. to 12 o'clock m. and from 1 p. m. to 5 p. m. daily except Sundays and legal holidays. (Sec. 1, L. 1911, p. 513.)

Powers and Duties

Section 128. Said State Commissioner of Horticulture shall have power, and it shall be his duty:

(a) To exercise a general supervisory and directory control over the horticultural interests of the state;

(b) To enforce all laws relating to horticulture and horticultural interests;

(c) Provide for the dissemination of information to horticulturists upon subjects pertaining to their interests and cooperate with district horticultural inspectors in arranging for meetings, lectures and institutes and the instruction of horticulturists;

(d) Publish and distribute bulletins and reports embodying information upon horticultural subjects, the pests affecting and the diseases of horticultural plants and fruits, to horticulturists, horticultural societies, and others, as he shall deem proper;

(e) Arrange for holding, fix the date of and preside over the district horticultural inspectors' institute to be held as herein provided;

(f) Examine, upon request, specimens of fruit, fruit trees, nursery stock and other horticultural plants or products submitted to him, and report to the applicant the result of such examination;

(g) Appoint district horticultural inspectors and prescribe rules and regulations for the (their) guidance and instruct, advise, direct and supervise them in all matters pertaining to their duties;

(h) Hear and decide appeals from the orders and decisions of district horticultural inspectors;

(i) Grant licenses to nurserymen, tree dealers and their solicitors, agents and salesmen, and suspend or revoke such licenses as herein provided;

(j) Furnish to state inspectors lists of licensed nurserymen and tree dealers doing business in the state, and of agents and salesmen of nursery stock in his and adjoining districts;

(k) Approve the bonds of state horticultural inspectors and of nurserymen and tree dealers as herein provided; and,

(l) Perform such other duties as may be prescribed by law. (Sec. 3075., R. & B.)

Duties of District Inspectors

Section 129. District horticultural inspectors shall have power and it shall be their duty:

(a) To enforce the provisions of all laws relating to horticulture, within their respective districts;

(b) To arrange for and hold institutes and meetings of horticulturists for the discussion of horticultural subjects and the dissemination of information as to horticultural questions, and for the demonstration of methods of preventing the diseases of or pests injurious to horticultural plants and fruits, and of curing and removing the same;

(c) To inspect orchards, nurseries, nursery stock, fruit, horticultural products, supplies, packing houses, warehouses and other places where fruit is packed, stored or shipped; also vines, ornamental shrubs and bushes, as well as other trees and property, for the purpose of ascertaining whether the same are infected with any disease or pests injurious to fruit trees or fruit, and of taking steps to disinfect the same and prevent the spread thereof; and, for that purpose, shall have free access to orchards, nurseries, packing houses, storage houses and any other place at all times;

(d) To require the disinfection of all trees, ornamental shrubbery, orchards, nurseries or nursery stock, fruit packing houses or other places infected with any pests, fungi or disease injurious to the horticultural industry of the state of Washington;

(e)) Inspect and examine orchards, fruit, nursery stock and other horticultural plants and products at the request of the owner thereof for the existence of any disease or pest thereof, and report to the applicant the result of such investigation and prescribe proper remedies therefor;

(f) Prevent the shipping and sale of infected fruit, except for canning, preserving or jellying or the making of cider or manufacture of other by-products within the state of Washington, and under such rules and regulations as may be established by the State Commissioner of Horticulture, and the delivery, sale, planting and shipping of infected nursery stock, trees, and other horticultural products and supplies, by notifying the owner thereof or the person having the

same in charge, and requiring the proper disinfection of the same;

(g) To disinfect, or cause to be disinfected, orchards, nursery stock, trees, fruit and other horticultural products and supplies, in case the owner or person having the same in charge shall not do so after notice; and, in case of trees, fruits, etc., which cannot be properly disinfected, to destroy the same, or cause same to be destroyed;

(h) To sort and repack, or cause to be sorted and repacked, infected fruit, if the owner thereof or the person having same in charge shall not do so after notice;

(i) Prevent the introduction and spread of diseases of or pests injurious to fruit trees and horticultural plants, fruit and other products, and to prescribe and specify the means and methods to be employed for the disinfection of trees, fruit and horticultural products;

(j) To issue certificates of inspection to nurserymen and tree dealers on stock inspected; and,

(k) Furnish to the board of county commissioners of each county wholly or partially within their respective districts, an estimate of expenses for each year. (Law 1909.) (Sec. 2, L. 1911, p. 512.)

Dealers in Nursery Stock—Licenses

Section 130. No person, firm or corporation shall engage in, continue in, or carry on the business of selling or dealing in nursery stock, fruit trees, ornamental shrubbery, or solicit purchasers of nursery stock, fruit trees or ornamental shrubbery within this state, or engage in the business of importing into this state for sale or distribution, nursery stock, fruit trees or ornamental shrubbery, either as owner thereof, or as agent of such owner, without first obtaining a license to carry on and conduct such business in this state. (Sec. 3083, R. & B.)

License Fee—Issuance of License

Section 131. The form of license shall be prescribed by the State Commissioner of Horticulture, and shall be issued by him upon proper application therefor. All licenses shall run for one year from date of issue. The license fee shall be $5 per annum for nurserymen and tree dealers, and $1 per annum for agents, salesmen or solicitors.

The State Commissioner of Horticulture shall prescribe the form of application for licenses, and no license shall be issued until the license fee shall have been paid and bond furnished as herein provided. All licenses shall be issued in the name of the owner, solicitor, salesman or agent as the case may be, and shall designate the business which may be carried on thereunder, and no license shall be assigned and transferred. Licenses to salesmen, agents or solicitors shall show the name and location of nursery or place of business of the nurserymen or tree dealers for whom he acts, and no license shall be granted to an agent, salesman or solicitor unless the party whom he represents shall have taken out a license and furnished bond as herein provided. (Sec. 3084, R. & B.)

Bond of Licensee

Section 132. Each licensed nurseryman and tree dealer under provisions of this chapter shall make, execute and deliver to the State Commissioner of Horticulture a bond running to the State of Washington in the sum of one thousand dollars ($1,000) with sureties to be approved by said commissioner, conditioned for the compliance by such licensee with all of the laws of the state of Washington, relative to the sale, disposition, delivery, inspection and disinfection of nursery stock, fruit trees or horticultural plants, dealt in, sold, handled or delivered by such licensee; also that all nursery stock, fruit trees or horticultural plants sold or delivered by such licensee shall be true to name and variety as represented: *Provided*, No liability shall attach by reason of stock being untrue to name, unless at least 5 per cent of any variety in any order shall so prove untrue to name. (Sec. 3085, R. & B.)

Record of Licenses

Section 133. The State Commissioner of Horticulture shall keep in his office a record of all licenses issued as herein provided, which records shall show the

character of the license, the name of the holder, the date of issuance, and the date of expiration. The bonds taken from tree dealers and nurserymen, as herein provided, shall also be filed with and held by said State Commissioner of Horticulture. (Sec. 3086, R. & B.)

Suspension or Revocation of License

Section 134. Upon report being made to the Commissioner of Horticulture by any horticultural inspector that any person, firm or corporation holding a license has not complied with, or is not complying with the laws of the state of Washington relative to such business, said State Commissioner of Horticulture may suspend the license of the person, firm or corporation and shall investigate the facts, and if it be ascertained that such licensee has violated the laws of the state relating to such business in any particular, such license shall be revoked. The cancellation or revocation of any bond furnished by any nurseryman or tree dealer as herein provided, shall *ipso facto* work a revocation of the license of such person and all agents, solicitors and salesmen employed by and representing him. (Sec. 3087, R. & B.)

Action on Dealers' Bonds

Section 135. Any person or persons suffering damage for any cause by reason of the infection of nursery stock bought by him or them, or by reason of receiving nursery stock, fruit trees or horticultural plants not true to the name as represented by the owner, solicitor, or agent selling the same, shall have recourse against the bond filed by the person from whom such stock was purchased for all damages sustained, which damages may be recovered by suit in any court of competent jurisdiction: *Provided*, No liability shall attach to bond unless at least 5 per cent of each variety ordered shall prove untrue to name. (Sec. 3088, R. & B.)

Conducting Business Without License—Penalty

Section 136. Any person, firm or corporation who shall carry on or conduct any business within this state for which a license is required as herein provided, and without first having procured said license and furnished bond as herein provided, shall be deemed guilty of a misdemeanor, and upon conviction thereof in any court of competent jurisdiction shall be subject to a fine of not less than fifty dollars ($50), nor more than one hundred dollars ($100), together with the costs of prosecution, and shall be committed to the county jail until such fine and costs are paid. (Sec. 3089, R. & B.)

False Representation—Penalty

Section 137. Any person who shall falsely represent that he is agent or representative of any tree dealer, nurseryman or dealer in fruit trees or horticultural plants, or ornamental shrubbery, shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be fined in any sum of not less than fifty dollars ($50), nor more than one hundred dollars ($100), together with the costs of prosecution, and shall be committed to the county jail until such fine and costs are paid. (Sec. 3090, R. & B.)

Pests and Diseases—Disinfection—Destruction of Infected Stock

Section 138. It shall be the duty of each person within the state of Washington owning premises on which there is or shall be growing or grown any nursery stock, fruit trees, shade trees, ornamental shrubbery or other horticultural plants, or the owner of any nursery stock, fruit trees, shade trees, ornamental shrubbery or horticultural plants situated upon premises leased or occupied by him, or the owner of any nursery stock, fruit trees, shade trees, ornamental shrubbery or horticultural plants situated or being at any place within the state of Washington, for the sale or delivery to any person, firm, or corporation to take, adopt, and use all methods and means provided by law or prescribed by the State Commissioner of Horticulture for the prevention of pests or diseases to which such nursery stock, fruit trees, shade trees, ornamental shrubbery or horticultural plants may be subject, and keep the same in a healthful condition and free from disease and pests; and in event it is found that such nursery

stock, fruit trees, shade trees, ornamental shrubbery or horticultural plants at any time are infected with any disease or pest to which the same may be subject, to promptly take and use such methods as may be prescribed by law or by the State Commissioner of Horticulture to disinfect the same, and in event such nursery stock, fruit trees, shade trees, ornamental shrubbery and horticultural plants cannot be disinfected to promptly destroy the same. (Sec. 3091, R. & B.)

Commissioner to Specify Diseases and Pests

Section 139. The diseases of and pests injurious to nursery stock, fruit trees, shade trees, ornamental shrubbery and horticultural plants to be guarded against and treated and disinfected for as in the next preceding section provided shall include any and all such diseases or pests as the State Commissioner of Horticulture shall specify and describe in the bulletins to be issued by him as injurious to the fruit and horticultural interests of the state. (Sec. 3092, R. & B.)

Directions for Disinfecting

Section 140. The State Commissioner of Horticulture shall prescribe the remedy for and the methods and means for the disinfection of fruit trees, horticultural plants, fruits and horticultural products, and shall make such rules and regulations relative thereto as he shall deem proper, which prescription and rules and regulations shall be promulgated by him by means of bulletins to nurserymen, fruit tree dealers, and their solicitors or salesmen, and to horticulturists of the state of Washington, through the district horticultural inspectors herein provided for, and any person interested shall be entitled to receive a copy of all such prescriptions and rules and regulations at any time, upon application for the same. (Sec. 3093, R. & B.)

Inspectors May Enter Premises

Section 141. For the purpose of ascertaining whether any nursery stock, fruit trees, shade trees, ornamental shrubbery, or other horticultural plants are infected with any disease or pests to which the same may be subject, the district horticultural inspectors, within their respective districts, shall be authorized to enter upon any premises at any time for the purpose of inspecting and examining any nursery stock, fruit trees or horticultural plants growing or stored thereon, or being situate thereon. (Sec. 3094, R. & B.)

Inspection of Stored Stock

Section 142. Said district horticultural inspectors shall also have the power, within their respective districts and at any time, to enter upon any premises where fruit or horticultural products are stored, or are being prepared or packed for shipment, or offered for sale, or are held for the purpose of delivery upon any shipment or sale thereof, for the purpose of inspecting said premises and such fruit or products to ascertain whether the same, or any part thereof, is infected with any of the diseases or pests declared injurious by the State Commissioner of Horticulture. (Sec. 3095, R. & B.)

Stored Stock—Owner to Disinfect—Destruction

Section 143. If, after inspection, as provided in the two preceding sections, the district horticultural inspector shall ascertain that any nursery stock, fruit trees, shade trees, ornamental shrubbery or horticultural plants, or any fruit or horticultural products, or any place where such fruit or horticultural products is kept for sale or is being prepared for shipment or is stored, is infected with any diseases or pests declared by the State Commissioner of Horticulture to be injurious to the horticultural industries of the state, said district horticultural inspector shall notify the owner or person having possession or charge of such nursery stock, fruit trees, shade trees, ornamental shrubbery, horticultural plants, fruit, horticultural products or places of storage, sale or preparation for market, in writing, requiring the disinfection of any or all thereof which is capable of disinfection, and the destruction of such as is incap-

able of proper disinfection, subject to the provisions hereof relative to the sale, disposition and use of infected fruit, and shall fix the time in said notice within which the same shall be so disinfected, or destroyed, as the case may be, and such owner or person having the same in charge shall proceed to disinfect or destroy such stock, trees or products, as the case may be, in the manner required by law and in the manner prescribed by the State Commissioner of Horticulture, and within the time specified in said notice. (Sec. 3096, R. & B.)

Separation of Infected from Healthy Stock

Section 144. In event of the infection of stock, trees or products, as hereinbefore specified, if a part only thereof is affected so that it cannot be properly disinfected, the owner or person in charge of the same shall have the privilege of separating the same into one or more of three classes, to-wit: Such as does not need disinfection; such as can be properly disinfected; and such as cannot be properly disinfected; and such owner or person in charge shall destroy such stock, trees or products as cannot be disinfected within the time specified in said notice, except in case of fruit which may be used or disposed of under the rules and regulations prescribed by the State Commissioner of Horticulture, as herein provided, and shall proceed to disinfect such as can properly be disinfected within the time specified in said notice. (Sec. 3097, R. & B.)

Inspector May Disinfect at Cost of Owner

Section 145. In the event of the failure of the owner or person in charge of such stock, trees or products to separate or disinfect or destroy the same, as in the last preceding section provided, and within the time specified in said notice, the district horticulture inspector shall have the right to enter upon the premises and perform the acts herein provided for, or cause the same to be performed, at the expense of the owner or person so having charge of such stock, trees, or products, and shall have the right to destroy all stock or products which are infected so that they cannot be properly disinfected. (Sec. 3098, R. & B.)

Recovery of Cost of Inspection—Lien

Section 146. In event of disinfection of any orchard, fruit trees, ornamental trees, shrubs, vines, horticultural plants, or other plants, fruits, horticultural products or other property by the district horticultural inspector, or any person under his direction or orders, the costs thereof shall be charged against the owner of such stock and the premises upon which the same may be growing, for the costs of such disinfection, or the destruction of the property which cannot be properly disinfected, which charge may be recovered in an action at law in the name of the State of Washington upon the relation of the district horticultural inspector against the owner or person having charge of such property, and shall also constitute a lien against the said property and the premises upon which the same may be growing, which lien may be enforced in any court of competent jurisdiction, and the bringing of an action at law to recover costs shall not be deemed to be, and shall not constitute, a waiver of such right of lien. (Sec. 3099, R. & B.)

Penalty for Failure to Disinfect

Section 147. Any person failing to disinfect or destroy any nursery stock, shade trees, ornamental shrubbery, fruit, horticultural products, or disinfect the premises upon which the same may be situate, as herein provided, within the time specified after notice from the district horticultural inspector of the district wherein the same is situated, shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be fined in any sum not less than fifty dollars nor more than two hundred and fifty dollars, and shall be imprisoned in the county jail until such fine is paid. (Sec. 3100, R. & B.)

Notice of Shipment of Nursery Stock

Section 148. It shall be the duty of each person, firm or corporation dealing in nursery stock or horticultural plants,

whether a resident of this state or of some other state or county, to notify the State Commissioner of Horticulture of his, their or its intention to ship any nursery stock, fruit trees or horticultural plants from one point in this state to another point in this state, or from any point without the state to a point therein, for sale or delivery or for planting or propagation. A copy of such notice shall also be mailed to the district horticultural inspector of the district into which such stock is to be shipped for sale or delivery. Said notice shall be mailed not later than the date of shipment, and the same shall show the name and address of both the consignor and consignee, a descriptive invoice of the goods to be shipped, specifying quantities and varieties, and the name of the person or transportation company from whom the consignee is to receive such goods. Said notice shall also show whether such stock, trees or horticultural plants have been inspected and passed at the initial point of shipment within this state by a district horticultural inspector. (Sec. 3101, R. & B.)

Carrier Not to Release Shipment Until Inspected

Section 149. Upon the arrival of any shipment of nursery stock, fruit trees or horticultural plants at its destination, it shall be the duty of the freight agent, express agent or the agent of the persons or transportation company having such shipment in charge for delivery, unless the same is accompanied by a certificate of inspection and approval by a district horticultural inspector showing that same was inspected and passed at the initial point of shipment within this state, to notify the district horticultural inspector of the district within which delivery is to be made, of the receipt of such shipment, giving the name of the consignor and consignee and stating that such shipment is ready for inspection and delivery. Said notification may be by telephone or telegraph, or by written notice delivered personally to said inspector, or left with some person of suitable age and discretion at his residence or office, or by mail addressed to said inspector at his place of residence; and the person having such stock in charge for delivery shall not deliver or turn over such shipment until the same shall have been inspected by said district horticultural inspector: *Provided, however*, Such agent shall not be required to hold such goods more than seventy-two hours after notifying said district horticultural inspector as aforesaid, except in case the notice is given by mail, in which event such goods be held for such period beyond said seventy-two hours as is ordinarily required from said point of delivery to the address of said inspector: *And provided further*, No inspection at point of delivery shall be necessary if shipment is accompanied by the certificate of a district horticultural inspector showing inspection and approval at initial point of shipment in the state as aforesaid, unless the person having same for delivery be notified by inspector of district where delivery is to be made, to hold for inspection by him: *And provided further*, That any nurseryman or tree dealer within the state may demand the services of an inspector during shipping season by paying four dollars per day for his services. (Sec. 3102, R. & B.)

Transportation Charges Paid Before Inspection—Remedy for Injury by Inspector

Section 150. No inspection of goods as provided in the last preceding section shall be made until all transportation charges thereon have been paid: *Provided, however*, The agent of any person or transportation company having such goods in charge for delivery may waive, in writing, the payment of such transportation charges prior to inspection: *Provided further*, The district horticultural inspector shall have privilege, at his option, to inspect said goods before payment of transportation charges, but in the event of any stock suffering damage by such second inspection or exposure, the owner thereof may have recourse against the bond of said inspector, if shipments shall have been accompanied by a copy of former inspector's certificate,

unless it is proven that the shipment contains stock not previously inspected. (Sec. 3103, R. & B.)

Inspection of Shipments—Entry—Notice to Disinfect or Destroy

Section 151. The district horticultural inspector shall have the right to enter upon any premises where nursery stock, fruit trees or horticultural plants are held or stored, when same have been shipped or sent to any point within his district for the purpose of sale or delivery, and to inspect such stock, trees and plants for the purpose of sale or delivery, and to inspect such stock, trees and plants for the purpose of ascertaining whether the same are infected with any of the diseases or pests to which the same may be subject, hereinbefore described; and, in event he shall find that such stock, trees, or plants, or any thereof, are infected with any such disease or pest, he shall at once notify the person in charge thereof, and having the same in his possession, not to deliver the same nor permit the same to be removed from his possession until they are disinfected; and he shall also notify the owner thereof or the agent of the owner, or the shipper thereof, that said stock is infected and requiring such owner, or his agent, to disinfect such part thereof as is capable of proper disinfection, within five days from the date of such notice, in the manner required by law and prescribed in the rules and regulations of the State Commissioner of Horticulture; and it shall be the duty of such owner or his agent, or the shipper of such goods to so disinfect or destroy such infected property within five days. (Sec. 3104, R. & B.)

Penalty

Section 152. Any person violating any of the provisions of the last preceding section hereof shall be deemed guilty of a misdemeanor, and upon conviction thereof, shall be fined in any sum not less than $50 nor more than $200, together with costs of action, and shall be committed to the county jail until such fine and costs are paid. (Sec. 3105, R. & B.)

Disinfection of Shipment by Inspector

Section 153. In event of the failure of the said owner or his agent, or the shipper of such disinfected goods to properly disinfect and destroy the same as required by the notice hereinbefore provided for, it shall be the duty of said district horticultural inspector, and he shall have power, to forthwith enter upon premises where such stock, trees or plants are situated and to properly disinfect or cause to be disinfected such part thereof as is capable of disinfection and to destroy such part thereof as is not capable of disinfection. (Sec. 3106, R. & B.)

Cost of Disinfecting Shipment—Charge Against Owner

Section 154. In case of disinfection and destruction of infected stock by the district horticultural inspector, as in the last preceding section provided, the cost thereof shall be paid by the owner of said stock or his agent or the shipper of said stock, and such charge shall be a lien upon said property, and the enforcement of such charges may be had in the same manner as provided for the enforcement of charges for inspection and disinfection of nursery stock and orchards as hereinbefore provided. (Sec. 3107, R. & B.)

Importation of Infected Stock—Penalty

Section 155. Any person or persons who shall willfully and intentionally bring into this state, or offer for sale or distribution whether gratuitous or for profit, within this state, any nursery stock, fruit trees or horticultural plants infected with any of the diseases or pests injurious to the same, shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine in any sum not exceeding one hundred dollars ($100), together with the costs of the action, and shall stand committed to jail until said fine and costs are paid. (Sec. 3108, R. & B.)

Damages by Reason of Infected Stock—Action on Bond

Section 156. Any person who shall suffer damage by reason of having purchased any nursery stock, fruit trees or

horticultural plants delivered within this state, or shipped from a point within or without this state for delivery within this state, by reason of such stock, fruit trees or plants being infected with any disease or pest injurious to the same, or by reason of the destruction of such stock, trees or plants after inspection thereof as herein provided, shall have a recourse upon the bond of the tree dealer or nurseryman furnishing such stock, which damages may be recovered in any court of competent jurisdiction of this state, at the suit of such injured party: *Providing*, No damages shall be recovered on account of infection of stock after the same has been inspected and passed. (Sec. 3109, R. & B.)

"Infection" Defined

Section 157. The term "infection" as used in this chapter shall mean the finding of any nursery stock, fruit trees, or horticultural products or supplies used in connection with horticultural products, to be affected by any one of the species of infection and disease or pest specified and described by the State Commissioner of Horticulture, as provided in section 3092. (Sec. 3110, R. & B.)

Inspectors—Qualifications for Service

Section 158. Every candidate for appointment to any position in the service of the Department of the Commissioner of Horticulture, unless he be a graduate of an agricultural college or similar institution in a department of agriculture and horticulture, shall be required to pass as (an) examination satisfactory to the Commissioner of Horticulture. (Sec. 3113, R. & B.)

Trees Sprayed Annually

Section 159. All fruit trees one year old or over shall be sprayed annually during the dormant season, in a careful and thorough manner by the owner thereof, or the lessee in charge of the property, with a lime and sulphur solution of the formula as prescribed by the State Commissioner of Horticulture: *Provided*, They are infected. (Sec. 3115, R. & B.)

Shipments Labeled

Section 160. Any fruit grown in the state of Washington and offered for sale or shipment in closed packages, shall be marked on the outside on the box or package with the name of the variety, or if the variety is unknown, shall be marked "variety unknown" and show the location where grown and the name of the grower or owner, and all boxes or packages of apples, pears and peaches shall be marked with the number in each package or the tiers packed; and the name of no other place or locality shall appear on any box or package of such fruit, except the address of the place to which it is shipped, in case of shipment. (Sec. 3116, R. & B.)

Proceedings of State Horticultural Association

Section 161. The secretary of the State Horticultural Association shall within thirty days after the regular annual session of the association deliver the minutes and proceedings of said session to the State Commissioner of Horticulture, who shall edit and cause the same to be published in connection with such official information as may be available for their purpose in the office of the Commissioner of Horticulture. An appropriation shall be made by the Legislature to cover the cost of such publication and the public distribution of the same. (Sec. 3117, R. & B.)

District Inspectors May Be Transferred

Section 162. The State Commissioner of Horticulture shall have the power to temporarily transfer district horticulture inspectors or their assistants from one district to another, as he may deem necessary to the performance of his duties. (Last paragraph Sec. 3, Chap. 112, L. 1911, page 515.)

Records Open to Public

Section 163. All records, reports, data and information kept and compiled by the State Commissioner of Horticulture shall be kept in his office and shall be a public record, open to the inspection of any person interested, during the reg-

ular office hours of each business day. (Sec. 3119, R. & B.)

Oaths and Bonds—Filed Where

Section 164. All oaths and bonds provided for herein shall be filed with the State Commissioner of Horticulture, except the oath and bond of said Commissioner, and his deputy, which shall be filed with the Secretary of State. (Sec. 3120, R. & B.)

Sales—Duplicate Orders

Section 165. All nurserymen and dealers in fruit trees or horticultural plants, and all salesmen, solicitors and agents for such, shall give to any person ordering any fruit trees or horticultural plants from or through them, a duplicate copy of such order, which shall show:

(a) The name and location of the nursery where such stock is grown;

(b) The name of the nurseryman, dealer, solicitor, salesman or agent taking such order;

(c) The date of the order and date when delivery to be made; and,

(d) The number, name and price of each variety of trees or plants ordered. (Sec. 3122, R. & B.)

Fraudulent Sale of Fruit or Ornamental Trees

Section 166. Any person or persons who shall misrepresent, deceive or defraud any person or persons in the sale of any fruit, shade or ornamental tree or trees, or any vine, shrub, plant, bulb or root, by substituting inferior or different varieties, or who shall falsely represent the name,, age or class of any such fruit, shade or ornamental tree or trees, or any vine, shrub, plant, bulb, root, garden or field seeds, shall be guilty of a misdemeanor, and on conviction be fined not less than $10 nor more than $200, or by imprisonment in the county jail not less than 30 days nor more than six months, or by both such fine and imprisonment, and shall be liable to the party or parties damaged or injured thereby in treble the amount of all damages sustained, to be recovered in any court having jurisdiction thereof. (Sec. 3123, R. & B.)

Sales—Misrepresentation—Penalty

Section 167. Any nurseryman, tree dealer, salesman, solicitor or agent falsely representing or stating that nursery stock, fruit trees or horticultural plants for which an order is taken are or have been grown in, or are to come from, a certain nursery or locality when in fact the stock, trees, or plants actually delivered are or have been grown in, or come from another nursery or locality, shall be deemed guilty of a misdemeanor, and, upon conviction thereof shall be fined in any sum not less than $50 nor more than $200, and shall be committed to the county jail until such fines and costs are paid. (Sec. 3124, R. & B.)

Certificate of Inspection

Section 168. The several district horticultural inspectors shall, upon the inspection of any nursery stock, trees or plants, issue and deliver to the owner or person in charge thereof a certificate of inspection, over his signature, showing date of inspection, and condition of such stock, trees or plants. (Sec. 3125, R. & B.)

Misuse of Certificate—Penalty

Section 169. Any person to whom a certificate of inspection shall have been issued, showing approval of the stock, property or material so inspected, who shall substitute for such work, property or material so inspected and approved, any other stock, property or material not covered by said certificate, and ship, sell or dispose of the same under said certificate of inspection, shall be deemed guilty of a misdemeanor, and, upon conviction thereof, shall be fined in any sum not less than one hundred dollars ($100) nor more than five hundred dollars ($500), together with the costs of action, and shall be committed to the county jail until such fine and costs are paid. (Sec. 3126, R. & B.)

Shipments of Foreign Stock—Costs of Inspection—Payment

Section 170. In the event of the shipment into the state of Washington from a point without said state, of any nursery stock, fruit trees, horticultural plants, shade trees, ornamental shrubbery, bushes

or vines, by any person, firm or corporation not licensed as herein provided, the purchaser or the person receiving shipment of such trees, stocks, plants, ornamental shrubbery or vines, shall have the same inspected in the same manner as is required upon the delivery of stock sold and delivered by licensed nurserymen or tree dealers, and shall pay as inspector's fee 10 per cent of the invoice price, the minimum fee to be 50 cents: *Provided*, That nurserymen or tree dealers, licensed under the provisions of this act to do business in this state, shall not be required to pay the inspector's fees provided for in this section. (Sec. 3127, R. & B.)

Hindering Inspector—Penalty

Section 171. Any person offering any hindrance to the carrying out of this act or in any manner preventing or hindering any inspection herein provided for shall upon conviction be fined not less than twenty-five dollars ($25) nor more than two hundred dollars ($200), together with costs, and shall be committed to the county jail until such fine and costs are paid. (Sec. 3134, R. & B.)

Sale of Adulterated Compound for Spraying

Section 172. It shall hereafter be unlawful for any person, firm or corporation, doing business in the state of Washington, to sell or offer for sale adulterated or low-grade Paris green, arsenic, London purple, sulphur or any spray material or compound for spraying purposes. (Sec. 3135, R. & B.)

Per Cent of Certain Ingredients

Section 173. For the purposes of this act Paris green shall contain not less than 50 per cent of arsenic trioxide in combination, and not more than 4 per cent of water; soluble arsenic trioxide and commercial arsenic shall contain not less than ninety-six (96) per cent of arsenic trioxide. (Sec. 3136, R. & B.)

Penalty—Disposition of Fines

Section 174. Any person, firm or corporation violating any of the provisions of this act shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine of not less than $25 nor more than $100. All fines imposed for violation of the provisions of this act shall be paid to the treasurer of the county wherein the violation was committed, and placed to the general fund of such county. (Sec. 3137, R. & B.)

Enforcement of Act—Who Charged With

Section 175. The State Commissioner of Horticulture and the county fruit inspectors under his supervision be charged with the enforcement of this act, with the assistance of the prosecuting attorney. (Sec. 3138, R. & B.)

Analysis of Spraying Compounds—Duty of State Chemist

Section 176. It shall be the duty of the chemist of the State Agricultural Experiment Station to correctly analyze, without extra compensation and without extra charge to the state, other than the necessary expenses, all substances and compounds used or offered for sale for spraying trees and plants, that the State Commissioner of Horticulture may send for analysis, and report to him without unnecessary delay the result of any analysis so made; any such chemist shall assist him in prosecuting violations of the law by giving testimony, expert or otherwise. (Sec. 3139, R. & B.)

Reference originally made in the statutes to others as executive or enforcing officers now apply solely to the Commissioner of Agriculture or his authorized representative

Chapter IX

Powers and Duties of Commissioner—(c) Vice the State Commissioner of Horticulture—Commission Merchants

Farm Produce—License from Commissioner of Horticulture—Bond

Section 177. It shall be unlawful for any person, firm or corporation to engage in the business of selling farm, dairy, orchard or garden produce on commission, or to receive or solicit consignments of such produce on commission in the state of Washington without first obtaining a license from the Commissioner of Horti-

culture to conduct and carry on the business of such commission merchant and giving a bond to the state of Washington, executed by a surety company authorized to do business in this state, the form of said bond to be approved by the Attorney General, for the benefit of persons intrusting such commission merchant with consignments of produce to be sold on commission, in the sum of three thousand dollars, said bond to be conditioned for the faithful performance of his duties as such commission merchant. (Sec. 7024, R. & B.)

License—Procedure to Obtain

Section 178. Any person, firm, or corporation desiring to carry on the business of such commission merchant in this state shall make application in writing under oath to the Commissioner of Horticulture, giving his full name if an individual, the full name of all the partners if a partnership, and the date of incorporation, the names of the officers, directors and stockholders, and the state where incorporated, and the amount of capital stock actually paid in, if a corporation, stating the name of the city or town where he intends to carry on such business, giving the street and number of building if practicable, and the character of produce for which a license to sell on commission is wanted. The applicant shall also deliver to the Commissioner of Horticulture the State Treasurer's receipt for the sum of $10, together with the bond mentioned in section 7024. Upon approval of said bond by Commissioner of Horticulture, it shall be the duty of the Commissioner of Horticulture to deliver to such applicant a license to carry on the business of a commission merchant until the thirty-first day of December of the year in which such license is issued. All bonds given under the provisions of this chapter, after their approval, shall be filed in the office of the Secretary of State: *Provided*, That all statements made under the provisions of this act shall be for the exclusive information of the Commissioner of Horticulture, and no other person or persons shall be permitted to see or examine the same unless the same shall be required for use in court, and in such case the Commissioner shall provide the same. (Sec. 7025, R. & B.)

Requirements as to Keeping of Books—Access to Books

Section 179. Every person, firm or corporation carrying on the business of a commission merchant under the provisions of this chapter shall keep an accurate and complete set of books, in which shall be truly recorded the amount and character of every consignment received by said person, firm or corporation, from any resident of the state of Washington, with the date of receipt, the name of the consignor and the condition of the shipment, when received, and when the same or any part thereof shall be sold. The name of the person, firm or corporation to whom sold, together with the amount and date of sale, shall be entered. The books of any such commission merchant shall at all times be open and subject to the inspection of the commissioner or the county fruit inspector or any of his deputies or to any consignor as to any entry concerning shipments made by him. (Sec. 7026, R. & B.)

Notice to Consignor of Receipt of Produce

Section 180. Any commission merchant who shall receive from any person, farm, dairy, orchard or garden products to sell on commission, shall immediately send to the consignor or consignors a statement in writing, showing what property has been received, and the condition thereof. If any such produce is received in a damaged condition and is unfit for sale, or if the markets are overstocked, it shall be the duty of such commission merchant to notify the State Horticultural Commissioner, or county fruit inspector, and take from him a certificate that said produce is not salable and that it is necessary to destroy the same. Said certificate shall be made in duplicate and one copy thereof shall be transmitted to the consignor. (Sec. 7027, R. & B.)

Statement, After Sale, to Consignor

Section 181. Whenever any commission merchant sells all or a portion of

any produce consigned to him to be sold on commission, he shall, within two days thereafter, render a true statement to the consignor, showing what portion of such consignment has been sold, the price received therefor, the date of sale, the name and address of the purchaser, if requested to do so in writing, and also all charges and expenses paid or incurred on account of such consignment. If any produce be sold for less than the market price that fact shall be noted on such statement, and the reason therefor shall be stated. (Sec. 7028, R. & B.)

Payment Within Ten Days—Maximum Rates

Section 182. It shall also be the duty of every person, firm or corporation carrying on the business of selling farm, dairy, orchard or garden produce on commission to pay to the consignor, within ten days after said sale, the full amount of money due upon the sale of any consignment of produce, after deducting therefrom the amount paid for transportation and drayage, if any, and the commission, which in no event shall exceed 10 per cent of the selling price, unless otherwise specified in writing. (Sec. 7029, R. & B.)

Complaints to Commissioner—Revocation of License

Section 183. Whenever any consignor, who has consigned farm, dairy, orchard or garden produce, to any commission merchant, shall have after demand received no remittance for the same or report of the sale thereof, or if in any case after report is made he is dissatisfied with the sale or the report thereof, he may make a verified complaint in writing to the Commissioner of Horticulture, who shall upon receipt of the same investigate the sale or sales complained of, and if upon such investigation it appears that the said commission merchant has failed or neglected to account for such consignment or any part thereof, or has failed or neglected to make a true and complete report thereof, it shall be the duty of the Commissioner of Horticulture to revoke the license of such commission merchant. Such investigation may be made by the county fruit inspector if the commissioner shall so direct. (Sec. 7030, R. & B.)

Action on Bond

Section 184. If any commission merchant shall make any sale of the produce mentioned upon commission and shall fail or neglect to pay the amount received upon such sale as hereinbefore provided, the owner or consignor of such produce may bring an action on the bond given by such commission merchant under the provisions of this chapter and recovery may be had against said commission merchant and the sureties on said bond for the amount due such owner or consignor; and in such action the court may allow a reasonable attorney's fee: *Provided*, If such commission merchant has failed or neglected to account for consignments of produce made to him by two or more consignors and the amount of said bond is not sufficient to pay the amount due all the consignors, they shall be entitled to receive from the proceeds of such bond a *pro rata* share in proportion to the amount due each of such consignors. (Sec. 7031, R. & B.)

Combinations, Pools, etc., Prohibited

Section 185. It shall be unlawful for any persons engaged in the business of commission merchants to enter into any combination, conspiracy or pool for the purpose of artificially raising or depressing the market price of any farm, dairy, orchard or garden produce, or of excluding from the market the produce of any particular locality grown or manufactured by any person within the state of Washington. (Sec. 7032, R. & B.)

Commission Merchant Defined

Section 186. For the purpose of this chapter a commission merchant is defined and declared to be any person, firm or corporation whose principal business is the sale of farm, dairy, orchard or garden produce on account of the shipper or consignor. (Sec. 7033, R. & B.)

Penalty for Violation of Act

Section 187. Any person, persons or corporation engaged in selling any property as herein specified who fails or neg-

lects to comply with any of the provisions of this chapter shall be guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine of not less than $25 nor more than $500. (Sec. 7034, R. & B.)

Revocation of License

Section 188. The Commissioner of Horticulture shall revoke any license issued under the provisions of this chapter whenever the person, firm or corporation holding the same shall be convicted of any violation of this chapter. (Sec. 7035, R. & B.)

Reference originally made in the statutes to others as executive or enforcing officers now apply solely to the Commissioner of Agriculture or his authorized representative.

"INSECTICIDE ACT"

By Act of Congress, 1910

An Act For preventing the manufacture, sale, or transportation of adulterated or misbranded Paris greens, lead arsenates, and other insecticides, and also fungicides, and for regulating traffic therein, and for other purposes.

It shall be unlawful for any person to manufacture within any territory or the District of Columbia any insecticide, Paris green, lead arsenate, or fungicide which is adulterated or misbranded. Violation is a misdemeanor punishable by fine of not to exceed $200 or imprisonment for not more than one year, or both fine and imprisonment.

Section 2. Introduction into or from any state or territory or the District of Columbia, or into or from any foreign country, of any insecticide, or fungicide which is adulterated or misbranded, is prohibited and declared a misdemeanor punishable as above. *Provided*, That no article shall be deemed misbranded or aulterated when intended for export to any foreign country and prepared or packed according to the specifications or directions of the foreign purchaser; but if said article shall be in fact sold or offered for sale for domestic use or consumption, then this proviso shall not exempt said article from the operation of any of the other provisions of this Act.

Section 3. The Secretary of the Treasury, the Secretary of Agriculture, and the Secretary of Commerce and Labor shall make uniform rules and regulations for carrying out the provisions of this Act.

Section 4. The examination of specimens of insecticides, Paris greens, lead arsenates, and fungicides shall be made in the Department of Agriculture, by such existing bureau or bureaus as may be directed by the secretary.

Section 5. It shall be the duty of each district attorney to whom the proper officer shall present satisfactory evidence of any such violation, to cause appropriate proceedings to be commenced and prosecuted in the proper courts of the United States, without delay, for the enforcement of the penalties as in such case herein provided.

Section 6. Defines the terms "Insecticide," "Paris green," etc.

Section 7. That for the purpose of this Act an article shall be deemed to be adulterated—

In the case of Paris green: First, if it does not contain at least 50 per centum of arsenious oxide; second, if it contains arsenic in water-soluble forms equivalent to more than 3½ per centum of arsenious oxide; third, if any substance has been mixed and packed with it so as to reduce or lower or injuriously affect its quality or strength.

In case of lead arsenate: First, if it contains more than 50 per centum of water; second, if it contains total arsenic equivalent to less than 12½ per centum of arsenic oxide (As^2O^5); third, if it contains arsenic in water-soluble forms equivalent to more than .75 per centum of arsenic oxide ($As^2 O^5$); fourth, if any substances have been mixed and packed with it so as to reduce, lower, or injuriously affect its quality or strength: *Provided, however*, That extra water may be added to lead arsenate (as described in this paragraph) if the resulting mixture is labeled lead arsenate and water, the percentage of extra water being plainly and correctly stated on the label.

In the case of insecticides or fungicides, other than Paris green and lead arsenate: First, if its strength or purity fall below the professed standard or quality under which it is sold; second, if any substance has been substituted; third, if any valuable constituent of the article has been abstracted; fourth, if it is intended for use on vegetation and shall contain any substance which shall be injurious to such vegetation when used.

Section 8. That the term "misbranded" as used herein shall apply to all articles herein included, the package or label of which shall bear any statement which shall be false or misleading in any particular.

That for the purpose of this Act an article shall be deemed to be misbranded—

In the case of insecticides, Paris greens, lead arsenates, and fungicides: First, if it be an imitation; second, if it be labeled or branded so as to deceive or mislead; third, if in package form, and the contents are stated in terms of weight or measure, they are not plainly and correctly stated on the outside of the package.

In the case of insecticides (other than Paris greens and lead arsenates) and fungicides: First, if it contains arsenic and the total amount of arsenic is not stated on the label; second, if it consists partially or completely of an inert substance and does not have the names and percentage amounts of each and every one of such inert ingredients plainly and correctly stated on the label.

Section 9. That no *dealer* shall be prosecuted under the provisions of this Act when he can establish a guaranty signed by the wholesaler, jobber, manufacturer, or other party from whom he purchased such articles to the effect that the same is not adulterated or misbranded.

Section 10. That any insecticide, Paris green, lead arsenate, or fungicide that is adulterated or misbranded and is being transported or held, shall be liable to be proceeded against in any district court of the United States within the district wherein the same is found and seized for confiscation by a process of libel for condemnation.

And if such article is condemned as being adulterated or misbranded, the same shall be disposed of by destruction or sale as the said court may direct.

Section 11. Provides for examination of samples of imported articles, for their destruction, exportation or bonding.

Section 12. Defines "Territory" and "Person."

Section 13. That this Act shall be known and referred to as "The Insecticide Act of 1910."

Section 14. That this Act shall be in force and effect from and after the first day of January, nineteen hundred and eleven.

Approved, April 26, 1910.

INSPECTION, CERTIFICATION AND TRANSPORTATION OF NURSERY STOCK

A brief synopsis of the laws and regulations of the United States, the several states and Canada, relative to the inspection, certification and transportation of nursery stock:

Alabama

A signed copy of the inspection certificate issued to the applicant must be filed with the State Horticulturist and money sent to pay for the license and tags needed. A tag must be placed on each order delivered. One tag on box does not cover individual orders therein. No one is allowed to receive a package of nursery stock unless a tag is attached.

Every nursery or nurseries, dealer or dealers in Alabama, and all outside of state nursery or nurseries doing business in Alabama, shall be required to take out a license before a certificate of inspection is granted. The license shall be of two kinds: one regular nurseryman and dealer's license and an agent's license, the agent's license to be obtained only through the principal, who must hold a regular nurseryman's or dealer's license. The license fee for each nurseryman's or dealer's license shall be $10. The fee for each agent's license shall be $1. All license fees to be paid be-

fore the license is granted. This rule to take effect on July 15, 1913.

Address all communications to State Horticulturist, Auburn, Ala.

Arizona

Dr. A. W. Morrill, State Entomologist of Arizona, Arizona Commission of Agriculture and Horticulture, Phoenix, Ariz.

Arkansas

Shipments of nursery stock into the state must be accompanied by a copy of the valid certificate of inspection, a copy of the valid permit issued to the nurseryman by the state entomologist of this state, and must bear the name and address of the consignor and consignee with a statement of the contents of the shipment; all shipments not so labeled or tagged must be refused for shipment by the carrier. Carriers bringing into the state shipments of nursery stock which originated in foreign countries or foreign possessions of the United States must notify the state entomologist in writing and must hold such stock at any place designated by him until the same has been duly inspected and released.

Nurserymen located out of the state may secure permits by filing with the state entomologist a copy of their certificate. Geo. G. Becker, Acting State Entomologist, Fayetteville, Ark.

California

Shipments of nursery stock into California are held by the transportation companies until inspected by state quarantine guardians. All packages must be marked with the name and address of the shipper, name of the consignor and name of the place where the stock is grown. All nursery stock infested with pests not existing in California will be immediately sent out of the state or destroyed at the option of the owner and at his expense. Peach, apricot and almond trees coming from districts where yellow and rosette are known to exist shall be refused entry and shall be destroyed or returned to the shipper. Notices of shipment of nursery stock to California should be sent to the horticultural quarantine officer, room 11, Ferry building, San Francisco, Cal., and to the state quarantine guardians at the point of destination. Frederick Maskew, Chief Deputy Quarantine Officer, Room 11, Ferry Building, San Francisco, Cal.

Colorado

The state entomologist has general supervision of the inspection of nurseries and orchards to prevent the introduction and spread of injurious insects and plant diseases. County horticultural inspectors in fruit-growing counties of the state are appointed by the county commissioners. All nursery stock coming into the state must bear certificates of inspection and fumigation, and on arrival in counties that have inspectors is turned over to them and released to consignee if it passes inspection. C. P. Gillette, State Entomologist, Fort Collins, Colo.

Connecticut

All nursery stock shipped into this state shall bear on each package a certificate that the contents of said package have been inspected by a state or government officer and that said contents appear free from all dangerous insects and diseases. If nursery stock is brought into the state without such a certificate, the express, freight, or other transportation company or person shall, before delivering shipment to consignee, notify the state entomologist of the facts, giving name and address of consignee, origin of shipment, and approximate number of cars, boxes, or packages, and probable date of the delivery to the consignee. The state entomologist may cause the inspection and if infested the treatment of the stock. No person, firm, or corporation shall unpack any woody field-grown nursery or florists' stock brought into this state from foreign countries except in the presence of an inspector, unless given permission to do so by said state entomologist or one of his deputies. If such stock is found infested with any dangerous pests the state entomologist may at his discretion order it treated. Any person violating any of the provisions of this act shall be fined not more than $50. Dr. W. E. Britton, State Entomologist, New Haven, Conn.

Delaware

Shipments of nursery stock into the state must bear a certificate of inspection and also a certificate stating that the stock has been properly fumigated. All nursery stock not accompanied by proper certificates may be held by the transportation companies until it can be inspected. Wesley Webb, Secretary, State Board of Agriculture, Dover, Del.

Florida

All shipments into the state shall have attached to each package a certificate stating that the contents have been stripped of foliage and fumigated as per rules and regulations. All persons selling nursery stock without the state shall pay a fee of $5 per annum and register with the inspector of nursery stock, file a certificate of inspection and receive permission to sell nursery stock in the state. It is declared unlawful to knowingly sell or transport any infested or infected nursery stock in the state. Rules and regulations may be obtained by addressing E. W. Berger, Inspector of Nursery Stock, Gainesville, Fla.

Georgia

Nurseries are inspected annually. A signed duplicate of inspection certificate, together with a statement by the nurserymen that all stock intended for Georgia will be fumigated in accordance with directions furnished them, must be filed in the office of the state entomologist. Official tags of the Georgia State Board of Entomology will be furnished by the state entomologist at the following price: One hundred tags, 60 cents, postpaid; 200 tags, 85 cents, postpaid; 300 tags, $1.10, postpaid; 500 tags, $1.35, sent by express, collect; 1,000 tags, $2, sent by express, collect. Each shipment of nursery stock into the state of Georgia must bear the official tag of the Georgia State Board of Entomology and also a duplicate certificate of inspection of the state from which the shipment is made. E. L. Worsham, State Entomologist, Atlanta, Ga.

Idaho

No person, firm or corporation shall import or sell nursery stock without first applying to the State Board of Horticultural Inspection and filing a bond in the sum of $5,000 and securing annual license upon payment of $10. Shipments into the state should bear a copy of an official certificate of fumigation emanating from the place where the stock was grown. All shipments into the state must bear a label showing the name of the shipper, the locality where grown and variety of nursery stock. All nursery stock, fruit trees or horticultural plants sold or delivered by principal or agents shall be true to name and variety as represented. All nursery stock shipped into this state, whether bearing certificate of inspection or not, must be inspected again upon its arrival, the consignee paying for such inspection. Every nursery firm doing business in this state must pay annually $1 additional for each agent who represents them. J. U. McPherson, State Horticultural Inspector, Boise, Idaho.

Illinois

State nurseries are inspected and certified not later than October 1. An inspection certificate shall be valid for one year from date of inspection. The state entomologist is authorized to revoke a certificate if he finds it is being used in violation of the law. He is also required to furnish all Illinois nurserymen with a list of state and government inspectors whose certificates may be received as equally valid as his own, and the nurseryman receiving stock under such certificates is authorized to substitute for them the Illinois certificate of inspection. Each dealer in nursery stock who has no nursery of his own and each agent for a nursery located outside of Illinois is required to furnish to the state entomologist annually a sworn statement, showing that the stock in which he deals has been duly inspected, and to submit for approval a copy of the certificate of inspection. Nursery stock shipped into the state must bear a certificate of inspection attached to each car, box, bale, bundle or package. Dr. S. A. Forbes, State Entomologist; P. A. Glenn, Chief Inspector, Urbana, Ill.

Indiana

All nurseries are inspected between June 1 and October 1 and at such other times as the head of the inspection department may consider advisable. Stock sent into or within the state must be plainly labeled with the name of the consignor and the consignee and must bear a certificate signed by a state or government official showing that the inclosed stock has been inspected and found free from injurious insects and plant diseases. All foreign-grown stock must be inspected upon arrival at its destination in Indiana. C. H. Baldwin, State Entomologist, Indianapolis, Ind.

Iowa

State nurseries are inspected at owner's request or if supposed to be infested with dangerously injurious insects or plant disease, and nurserymen are prohibited from selling or shipping without inspection. Shipments into the state must be accompanied by a certificate of apparent freedom from injurious insects or plant diseases. A copy of inspection certificate must be filed with and approved by the state entomologist. Prof. H. E. Summers, State Entomologist, Ames, Ia.

Kansas

Nurseries are inspected annually between June 15 and November 1. Certificates are valid until the first day of the following June. No nursery stock shall be brought into the state nor offered for sale within the state without having been properly inspected as shown by an accompanying certificate. State Entomological Commission, Topeka, Kan. Prof. Geo. A. Dean, Entomologist, Manhattan, Kan. Prof. S. J. Hunter, Entomologist, Lawrence, Kan.

Kentucky

Nurseries are inspected annually. Every package of nursery stock shipped into the state must have a copy of a certificate of inspection attached and bear on the label a list of the contents. Duplicate certificates of inspection may be filed with the state entomologist. Prof. H. Garman, State Entomologist, Lexington, Ky.

Louisiana

Nursery inspection is under the control of the State Board of Agriculture and Immigration. The entomologist of the experiment station will have charge of the work, so all communications concerning nursery inspection should be addressed to him.

The regulations of the board require every box, bundle, bale or package of nursery stock shipped into the state to be plainly labeled with a copy of a valid and unexpired certificate of inspection, and nurserymen shipping stock into this state must file a copy of their certificate with the board. J. B. Garrett, Entomologist, State Board of Agriculture and Immigration, Baton Rouge, La.

Maine

Nurseries within the state are inspected annually. All nursery stock shipped into the state shall bear on each box or package a certificate that the contents have been inspected. The state horticulturist has power to inspect all stock shipped into the state at point of destination, whether under certificate or not, and if found infested with any injurious insects or plant diseases he shall cause it to be destroyed or returned to the consignor. Agents or other parties, excepting growers, who sell or deal in nursery stock, or solicit purchasers of nursery stock, shall make application for an agent's license and shall file with the state horticulturist name and location of nursery and place of business of the nurserymen or tree dealers whom they represent or from whom they purchase their stock. Such application shall be accompanied by a fee of $5. A. K. Gardner, State Horticulturist, Augusta, Me.

Maryland

Nurseries are inspected at least once in six months. All nursery stock subject to attack of insect pests must be fumigated. Shipments into the state must be labeled with the name of consignor and consignee and each package bear a certificate of inspection. Duplicate certificates should be filed with the state entomologist. Dr. T. B. Symons, State Entomol-

ogist, Prof. J. B. S. Norton, State Pathologist, College Park, Md.

Massachusetts

Nurseries in the state are inspected annually. Agents or other persons, excepting growers, who desire to sell nursery stock in the state, shall make application to and receive from the state nursery inspector an agent's license, and shall file with the state nursery inspector names and addresses of all persons or nurseries from whom they purchase stock. It shall be unlawful for any person, firm or corporation to sell, deliver or ship within the state any nursery stock unless such person, firm or corporation holds a grower's certificate or an agent's license, and a copy of such certificate or license must accompany each car, box or package delivered or shipped.

The state nursery inspector shall have power to inspect at its point of destination all nursery stock coming into the state, and should such stock be found to be infested with injurious insects or plant diseases he may cause it to be destroyed, treated or returned to the consignor at the consignor's expense. Dr. H. T. Fernald, State Nursery Inspector, Amherst, Mass.

Michigan

Nurseries are subject to inspection; infested trees must be destroyed and the remainder of the stock within a half mile must be fumigated. Shipments into the state must bear on every package, plainly labeled, the name of the consignor and consignee, statement of contents and a certificate showing that the contents have been inspected by a state or government officer, and if of species subject to the attack of San Jose scale must be fumigated with hydrocyanic acid gas. Certificates of fumigation must also be attached, together with a certificate of inspection. This applies to individual orders when several are contained in the same shipment. All nurserymen, whether residents of Michigan or other states, who wish to grow or sell stock within the state must apply to the state inspector of nurseries on or before August 1 of each year for a license, for which the fee is $5. A bond for $1,000 must also be filed. Certificates of inspection must be filed with the state inspector of nurseries before any stock is shipped into the state. Prof. L. R. Taft, State Inspector of Nurseries, East Lansing, Mich.

Minnesota

Inspection, annual compulsory. Inspection may be oftener if it seems desirable.

Shipments into the state must be accompanied by a certificate of inspection.

Carrying companies accepting stock not so tagged are responsible and liable to prosecution.

Dealers in other states sending stock into Minnesota for sale must file a copy of their certificates with the state entomologist. Professor F. S. Washburn, State Entomologist, St. Anthony Park, Minn.

Mississippi

Every nursery in the state must be inspected before November 1 of each year, and every bundle, bale or package of stock sold or transported must be accompanied by a copy of the certificate of inspection attached in a conspicuous place. Every person or firm from other states wishing to ship nursery stock into Mississippi must file with the entomologist a copy of their certificate, which shall state that the nursery is properly equipped for fumigating all nursery stock. A copy of the certificate shall be attached to every bundle, bale or package of nursery stock delivered within the state. Every nurseryman must state that all nursery stock shipped into this state will be fumigated with hydrocyanic acid gas. R. W. Harned, Entomologist, Agricultural College, Miss.

Missouri

Nurseries are inspected annually. Each nursery outside of Missouri shipping stock into Missouri must apply at the office of the chief inspector for a permit, which will be issued upon filing the necessary papers and copy of their nursery inspection certificate. No fee is charged for the permit. All agents or salesmen for outside nurseries must ap-

ply for an agent's permit. Every package of nursery stock shipped into the state must be clearly labeled with the name of the consignor, consignee, statement of contents and a certificate showing that the stock therein contained has been inspected where grown by a duly authorized inspector and found to be apparently free from dangerously injurious insect pests and plant diseases. Transportation companies are not permitted to deliver nursery stock unless so labeled. Leonard Haseman, Entomologist and Chief Inspector, University of Missouri, Columbia, Mo.

Montana

All stock brought into the state must be unpacked, inspected, and fumigated if necessary, at one of the designated quarantine stations, viz.: Glendive, Miles City, Billings, Bozeman, Lewistown, Helena, Great Falls, Missoula, Victor, Como, Darby, Plains, Mondak, Glasgow, Havre, Kalispell and Eureka. Nursery stock may be inspected and fumigated at other points of delivery on payment of all costs. To sell or deliver nursery stock it is necessary to first obtain a license by paying a fee of $25 and by filing with the state horticulturist a bond in the sum of $1,000 annually. All correspondence and notice of shipment, including an invoice of stock, must be sent to M. L. Dean, State Horticulturist, Missoula, Mont.

Nebraska

All nursery stock shipped into the state shall be labeled with the names of consignor and consignee and a certificate showing inspection since July first preceding. Prof. Lawrence Bruner or Prof. Myron H. Swenk, Assistant State Entomologist, University of Nebraska, Lincoln, Neb.

Nevada

Nursery stock shipped from other states shall bear on the outside of each car, bale or package a label giving the names of the consignor and consignee, together with a copy of an inspection certificate of recent date. Such certificate of inspection must bear the signature of a qualified person in authority in the state in which such nursery stock was grown. No transportation company shall deliver any nursery stock lacking such official certificate of inspection. J. E. Stubbs, President State University, Reno, Nev.

New Hampshire

Nurseries are inspected at least once each year. Shipments into the state must be accompanied by a certificate of inspection or, in lieu thereof, an affidavit showing that the stock has been fumigated with hydrocyanic acid gas, using not less than 2/10 of 1 gram of cyanide of potassium per cubic foot of space, in an air-tight compartment for not less than 40 minutes. A copy of the certificate of inspection or a copy of the affidavit must be attached to each car, box or package shipped into the state. Commissioner of Agriculture, Durham, N. H.

New Jersey

The law requires the inspection of all nurseries at least once in each year. Shipments into the state must be accompanied by a certificate of inspection, or copy thereof, attached to each car or parcel, together wth a statement from the shipper that the stock herein is a part of the stock inspected, and stating whether such stock has been fumigated with hydrocyanic gas or not. It shall be the duty of all carriers to refuse for transportation within the state all stock not accompanied by a certificate of inspection.

All stock coming into the state may be detained for examination, wherever found, by the state entomologist or the state plant pathologist, and if found to be infested with any insects or plant diseases, injurious or liable to become so, will be destroyed. Dr. T. J. Headlee, State Entomologist, New Brunswick, N. J., State Plant Pathologist, New Brunswick, N. J.

New Mexico

No law relative to transportation of nursery stock. The Territorial Legislature of 1903, provided for county boards of horticultural commissioners which were given authority to control orchard pests. Prof. Fabian Garcia, Horticul-

turist, Agricultural Experiment Station, State College, N. M.

New York

All nursery stock shipped from any point in the state of New York must have attached a copy of a certificate of inspection issued by the State Department of Agriculture.

All transportation companies bringing nursery stock into this state shall immediately notify the Commissioner of Agriculture and give name of consignor and consignee and the points of shipment and destination of each consignment.

Importers of Nursery Stock and Custom-House Brokers

All custom-house brokers bringing into this state any nursery stock shall file their names with the Commissioner of Agriculture.

Custom-house brokers importing or bringing nursery stock into the state shall immediately, upon receiving consignments, notify the Commissioner of Agriculture.

(Blanks will be furnished for this purpose.)

All dealers in nursery stock must, if they have no growing nursery stock in this state, file with the Commissioner of Agriculture their name and address. No stock shall be sold, shipped or delivered unless accompanied by a copy of a certificate signed by the Commissioner of Agriculture. When all such stock is collected an inspection will be made and proper certificates provided by this department to permit shipping.

All growing nursery stock in the state will be inspected annually or oftener if necessary; if found free from injurious insects or fungous disease there will be issued to the owner a certificate of inspection, which certificate will expire September 1.

Every car, box, bundle or package must have attached an exact copy of said certificate before shipment or delivery.

All nursery stock found growing within one-half mile of areas infested with San Jose scale must be properly fumigated.

No nursery stock received from points within the state of New York shall be sold or delivered unless it bears a valid certificate of inspection on arrival.

Any nursery stock brought into the state must remain packed and unopened until permission is given by the Commissioner of Agriculture. To facilitate rapid inspection, receivers of nursery stock should notify the department office at Albany or an authorized inspector of the receipt or expected receipt of consignments, giving the name and address of consignor and dates.

North Carolina

Every shipment of nursery stock into this state must be accompanied by a valid copy of a certificate of inspection. Every person, firm or corporation desiring to ship nursery stock into this state must file a copy of their certificate with the entomologist. It will be of advantage to the nurserymen if they attach a guarantee of fumigation to the ship ment. A copy of regulations will be sent on application. Franklin Sherman, Jr., Entomologist State Department of Agriculture, Raleigh, N. C.

North Dakota

The director of the experiment station is authorized to cause inspection and prescribe treatment of diseased nursery stock. Shipments into the state must bear a certificate of inspection. Every person who employs agents or salesmen or who solicits for the the sale of nursery stock must obtain a license upon the payment of $10 and upon filing a certificate of inspection and a $500 bond. Said license will permit holder to do business in the state a year. Director North Dakota Experiment Station, Agricultural College, N. D.

Ohio

Shipment of nursery stock entering the state must bear the name of the consignor and consignee and be accompanied by an official certificate of inspection or fumigation. Agents are required to pay a license fee of $1 and dealers a license fee of $5, also to file sworn statements that the stock whieh they sell or deliver has been officially inspected and was received by them accompanied with a valid

certificate of inspection or fumigation. N. E. Shaw, Chief Inspector, Ohio Department of Agriculture, Columbus, Ohio

Oklahoma

Nurseries are inspected annually. No nursery stock shall be brought into the state without having been previously properly inspected as shown by an accompanying certificate. Benjamin Hennessy, Secretary, State Entomological Commission, Oklahoma City, Okla.

Oregon

The State Board of Horticulture has charge of inspection within the state. All nursery stock brought into the state must be inspected at station of delivery before delivery to consignee. If found infected or infested, nursery stock must be returned to consignor or destroyed. Peach pits, peach trees and scions and other trees on peach roots grown in or coming from districts where peach yellows, little peach rosette, or either of them, are known to exist are prohibited entry. Every carload and case containing nursery stock, trees, plants, etc, must have plainly marked thereon in a conspicuous place and manner the name and address of the consignor, the name and address of the consignee, the name of the country, state or territory where contents were grown; and must show that it contains nursery stock, seedlings or seeds. Address State Board of Horticulture, Portland, Ore.

Pennsylvania

Nurseries must be inspected at least once a year, and no nurseryman, agent, dealer or broker can legally sell or ship stock without a certificate of inspection. Certificates of fumigation are required to accompany shipments from other states, and the word "fumigated" printed or stenciled on or accompanying the certificate of inspection will not be accepted unless it is apparent that such word is a part of the certificate granted by a state inspection officer.

Nurserymen from other states are required to file affidavits that all nursery stock of kinds subject to infestation by San Jose scale will be properly fumigated before shipment into the state. Blanks furnished upon application. Dealers in nursery stock are granted certificates upon application and the filing of a statement that they will buy nursery stock only from nurserymen or growers holding valid certificates of inspection.

Transportation companies are required to reject all stock entering the state unless certificates of inspection and fumigation are attached. Prof. H. A. Surface, Economic Zoologist; Enos B. Engle, Chief Nursery Inspector, Harrisburg, Pa.

Rhode Island

The Inspection Law has been revised during the past year and now provides that the State Board of Agriculture shall appoint a state entomologist whose duties it shall be to inspect nurseries and orchards and to grant an annual certificate for sale of nursery stock. All nursery stock shipped into the state must bear on each package a certificate that the contents have been inspected by an authorized inspection officer. The state entomologist is, furthermore, authorized to inspect any nursery stock which comes into the state, even when sent in under an official certificate, if he deems it advisable, and shall order its return to the consignor if any injurious insects or plant diseases are found therein.

An affidavit of fumigation is no longer accepted in lieu of official inspection.

Agents who have no nursery, and who wish to sell nursery stock within the state, must apply to the state entomologist for an agent's license and must state where they propose to purchase their stock to be sold A. E. Stene, State Entomologist, Kingston, R. I.

South Carolina

Stock coming from other states, provinces or foreign countries and consigned to points within this state must have attached to every bundle or package an interstate tag or permit issued by the South Carolina Crop Pest Commission. This interstate tag or permit can be issued only after the certificate of inspection of the state, country or province where shipment originated has been approved by the South Carolina State Crop Pest Commission and filed in the office of

the entomologist or pathologist of the said commission. It is further required that the fumigation certificate of the South Carolina State Crop Pest Commission be properly filled out and filed in the office of the entomologist or pathologist of the commission before the interstate tag or permit can be issued, unless the official inspection certificate includes a statement that the nursery is properly equipped for fumigating. Prof. A. F. Conradi, State Entomologist; Prof. H. W. Barre, State Pathologist, Clemson College, S. C.

South Dakota

All nursery stock shipped into the state must be accompanied by a certificate of inspection issued by the state entomologist of the state from which it was shipped. Any person, firm or corporation owning a nursery which sells stock to be delivered in this state must certify where the stock was grown and attach this statement to all shipments. Prof. H. C. Severin, State College of Agriculture, Brookings, S. D

Tennessee

Nurseries are inspected annually or oftener if necessary. Any person, firm or corporation without the state, desiring to do business within the state, shall file with the state entomologist and plant pathologist a copy of his certificate of inspection issued and signed by proper official of his state, as well as an agreement to fumigate properly all stock shipped into the state. Every shipment must be accompanied by a copy of said certificate of inspection and a fumigation tag. Every individual sale or bill of trees shall bear a copy of certificate. Failure to comply with the requirements subject stock to confiscation. Prof. G. M. Bentley, State Entomologist and Plant Pathologist, Knoxville, Tenn.

Texas

Nurseries and greenhouses are inspected annually. All shipments of nursery stock originating outside the state must bear shipping tags showing copy of certificate of inspection from the state inspector of the state in which the shipment originates, but in addition thereto they must have a tag attached showing copy of permit from Texas. No nursery stock shall be shipped into the state without first filing with the commissioner of agriculture a certified copy of a certificate of inspection from the state inspector of the state in which the shipment originates. A fee of $5 is required for issuance of permit to ship into the state. Agents or dealers operating in Texas for nurserymen outside of the state must procure proper agents, credentials from their nurseries, on an approved form. Sam. H. Dixon, Chief Inspector, Houston, Tex.

Utah

No person shall engage in the business of selling or importing nursery stock without having first obtained a license to do business in the state. Any person may obtain a license from the State Horticultural Commission upon the payment of a fee of $2 50 annually and by filing with the State Horticultural Commission a bond in the sum of $500. Each salesman or agent must hold a certificate giving his name and the name and address of the persons he represents, together with the license number of his principal. A copy of the certificate of inspection must be attached to each shipment. All nursery stock will be quarantined on arrival, and, if deemed necessary, disinfected or destroyed at the cost of the owner. J. Edward Taylor, State Horticultural Inspector, Salt Lake City, Utah.

Vermont

Nurseries are inspected annually. Nursery stock shipped into the state shall be accompanied by a certificate of inspection and the name and postoffice address of the consignor and consignee. M. B. Cummings, State Nursery Inspector, Burlington, Vt.

Virginia

Before selling nursery stock, it is necessary to procure from the auditor of public accounts, Richmond, Virginia, a certificate of registration, for which the fee is $20 for principals; duplicates for agents' use free. Send certified check or draft for $20 drawn or indorsed payable to the Treasurer of Virginia. (Personal

checks will not be accepted.) Duplicate of certificate of nursery inspection must be filed with the state entomologist, who will furnish tags at cost, and one tag must be attached to each package of stock to be sold in the state. W. J. Price, Acting State Entomologist, Blacksburg, Va.

Washington

No person, firm or corporation shall engage or continue in the business of selling as agent, solicitor or otherwise within the state or importing nursery stock without first having obtained a license. Nursery license fee is $5 per year; nursery agent's license fee is $1 per year; nursery bond is $1,000, to be renewed annually. Every person, firm or corporation licensed to do business in this state must notify the Commissioner of Agriculture of his intention to ship nursery stock, giving the names and addresses of the persons, firms or corporations to whom the shipments are made. A copy of the notice shall also be sent the inspector of the district in which the point of destination is located. For full information address F. A. Huntley, Commissioner Horticulture, Olympia, Wash.

West Virginia

The State Crop Pest Commission has power to provide quarantine regulations concerning the transportation and sale of nursery stock. No person or corporation, either for himself or as agent for another, shall offer for sale, sell or deliver nursery stock unless he shall have first procured from the state auditor a certificate of registration, the annual fee for which is $5. All nursery stock entering the state must be accompanied by a certificate of inspection and also by an official permit tag obtained from the state entomologist. Duplicate certificates of inspection should be filed. W. E. Rumsey, State Entomologist, Morgantown, W. Va.

Wisconsin

All persons, firms or corporations shipping nursery stock into the state are required to file a duplicate certificate of inspection, and secure a state license at the cost of $5, if selling at retail or through agents. Each shipment must bear certificate tags which shall be attached to each package, box or carload lot. Transportation companies are forbidden to deliver nursery stock unless accompanied by valid certificate tags. All agents selling nursery stock within the state must be supplied with an agent's duplicate license at the cost of $1, which shall bear the same number and date as that of the principal. Wilful misrepresentation of quality or variety of stock offered for sale shall constitute a punishable misdemeanor. Professor J. G. Sanders, Entomologist and Chief Nursery Inspector, College of Agriculture, Madison, Wis.

Wyoming

Any person or firm wishing to do business in this state must first obtain a license Licenses are issued on application for a period terminating on July 1 of the next succeeding inspection year (approximately two years). All applications must be accompanied by the license fee of $25, a bond in the sum of $500, conditioned that the principal will faithfully obey the law of the state, and by a certified certificate of inspection from an authorized inspector in the state from which shipments are to be made. On receipt of these the secretary of the state board issues authorized shipping tags at cost. Nursery stock may not enter the state and transportation companies may not deliver unless such tag be attached to each and every box, bundle or bale. Before making shipments secure copy of the law from the secretary of the State Board of Horticulture, Professor Aven Nelson, Laramie, Wyo.

Canada

No nursery stock shall be imported that is infested with any of the following insect pests or diseases: San Jose scale, brown-tail moth, gypsy moth, woolly aphis, West India peach scale, potato canker, gooseberry mildew, internal and external parasitic diseases of potato, branch canker and blister rust of white pine. Nursery stock shall be imported only through the ports and during the periods mentioned:

Vancouver, B. C., from October 1 to May 1; Niagara Falls, Ont., from October

1 to May 15; Winnipeg, Man., and St. John, N. B, from March 15 to May 15, and from October 7 to December 7; Windsor, Ont., and St. Johns, Que., from March 15 to May 15, and from September 26 to December 7.

Importations by mail shall be subjected to the same regulations. The port by which it is intended that the nursery stock shall enter shall be clearly stated on each package, and notice of shipment must be sent to the Dominion Entomologist, Ottawa. European nursery stock and certain other classes of vegetation may in the case of certain ports be allowed to proceed and shall be inspected at point of destination, but must not be unpacked except in the presence of the inspector. Copies of the regulations governing the importation of nursery stock into Canada may be obtained from Dr. C. Gorden Hewitt, Dominion Entomologist, Ottawa, Canada, to whom all inquiries should be addressed.

(Regulations for shipment of nursery stock into Canada are to be revised about October 1, 1913.)

LEGUMES. See *Apple Orchard Cover Crops*.

LEGUMINOUS COVER CROPS, VALUE OF. See *Soils*.

Lemon

The lemon is the fruit of the tropical or sub-tropical tree *Citrus Limonum* or *Citrus medica*, variety *Limonum*, of the orange family. The fruit is ellipsoidal with a protruding point at each end, the color is bright yellow, the rind is thick and the pulp and juice very acid.

The wild stock of the lemon tree seems to have been brought from the valleys of Kumaon and Sikkim in the northwest provinces of India. It was probably unknown to the Greeks and Romans in their days of power, and is supposed to have been introduced by the Arabs into Spain between the 12th and 13th centuries.

As a cultivated plant the lemon is now grown in almost all the tropical and subtropical countries of the world. In the United States it is chiefly grown in Florida and California, but it is grown to a limited extent in all of the Gulf states and in some of the southwestern states. Like the apple and the pear, the lemon varies considerably under cultivation.

Varieties

"Risso and Poiteau enumerate 47 varieties of this fruit, although they maintain as distinct the sweet lime, with eight varieties, and the sweet lemon, with 12 varieties.

"The lemon is more delicate than the orange, although it grows under practically the same conditions and requires similar treatment."—Encyclopedia Britannica.

The lemon tree is exceedingly fruitful and ripens its fruits during every month of the year, but the principal crop is harvested about the end of the year. The fruit is picked while green and packed in boxes preparatory to shipping, each lemon being wrapped in paper in much the same manner as oranges, or "Western boxed apples."

The culls, consisting of unsound, unripe or malformed fruit, are used for the manufacture of essential oils and juice. Lemon juice is often used for medicinal purposes, as a tonic to counteract malaria, or as a cure for scurvy and other diseases. A concentrated lemon juice generally known as citric acid is much used by physicians. Also the oil of lemons, which is obtained by pressing the rind, is used in medicines.

Since the lemon is so nearly in its habits like the orange we refer the reader to the article on orange for a fuller discussion of the subject. See *Orange*.

The varieties recommended for the various districts by the American Pomological Society are as follows:

For Map of Districts, see page 192.

District No. 6

HIGHLY RECOMMENDED: Belair; Eureka; Sicily; Villafranca.

RECOMMENDED: Genoa.

District No. 18

RECOMMENDED: Eureka; Lisbon; Sicibon; Villafranca.

RECOMMENDED: Genoa.

District No. 17

RECOMMENDED: Eureka; Lisbon; Sicily; Villafranca.

LEMON DISEASES

Blue and Green Mold

Penicillium italicum and *P. digitatum.*
See *Orange*

Twig Blight

Sclerotinia libertiana

The twigs die back from the tip in moist weather, showing to some extent a white moldy fungus upon the surface in which may be imbedded small, hard, seed-like bodies or sclerotia, at first white but finally becoming black. A mass of gum exudes at this point. This fungus, which is the same as that causing the cottony mold, occasionally infects the tree itself, both with lemons and other citrus trees, with the effect just described. The infection comes from spores produced by the growth of the fungus upon the green manure crop. Not serious.

Brown Rot

Pythiacystis citrophthora

A very virulent form of decay, spreading rapidly through the boxes from fruit to fruit. Affected specimens show a brown, rather dry decay of the rind upon which a delicate, scanty white mold develops when considerable moisture is present. Fruit out in the open shows no mold on the surface. Affected fruit has a peculiar odor which is very characteristic. Mostly seen in lemons held in storage for curing. In wet weather this decay often appears on the fruit while still on the tree, but it is mostly confined to that within two feet of the ground. The disease affects all kinds of citrus fruit in this manner.

The fungus which causes this trouble is primarily a soil inhabitant, living naturally in the ground beneath the trees where its spores are produced.

Orchard infection is prevented by keeping the trees pruned up somewhat from the ground, cultivating the soil under the trees in summer and covering it in winter with straw or a green cover crop. Spraying the ground under the trees in winter with thick Bordeaux mixture is also helpful. The worst infection, that of lemons in storage, is contracted in the tank of the washing machine where the water becomes extremely infectious from the presence of spores brought in with the orchard soil and dust. This is easily controlled by disinfection of the wash water with copper sulphate.

Literature

Bulletins 190, 218, California Experiment Station.

Cottony Mold—White Rot

Sclerotinia libertiana

Causes decay of the fruit in the curing house with the production of an abundant white mold spreading over the lemons. In this mold are found irregularly-shaped, black, seed-like bodies called sclerotia, from which another stage of the fungus develops. The same fungus also develops in the orchard soil during the rainy season and often becomes very abundant upon green-manure crops or other vegetation growing about the lemon trees, particularly upon the vetch. The sclerotia develop upon green-manure crops or directly upon the soil, the latter during the rainy season, and out of them grow little funnel-shaped toadstool-like bodies which give off the spores of the fungus.

Infection occurs in wounds in the presence of moisture, generally from the washing water and usually at the stem end.

Washing in bluestone solution of the same strength used for brown rot does not kill the spores.

In regard to the control of this trouble, we may say that the cottony mold has had a very marked prevalence since the use of vetch as an orchard cover crop became so general.

There is much ground for believing that these facts are related to one another, cottony mold having become more abundant on account of the opportunity given for its development in the orchard by the presence of the vetch plant, upon which it develops particularly well.

Literature

Bulletins 190, 218, California Experiment Station.

Gray Mold

Botrytis vulgaris

This produces a dark-colored decay of the rind, on which a dirty gray mold develops. The fungus is able to develop at low temperatures close to the freezing point, and sometimes causes considerable loss in fruit held in cold storage. Not ordinarily very serious.

Lemon Gummosis

Characterized by the exudation of gum from the trunk of the tree just above the point of budding. The tree appears yellow and dies when badly affected. Occurs on poorly drained, heavy soil, especially if the point of budding is deeply covered with earth, and where the soil about the trunk is undisturbed by cultivation. This trouble is more common on lemons than on oranges.

In order to successfully control gum diseases in orchard trees, soil conditions must first of all be improved by securing drainage, removing soil from about the bud and thoroughly cultivating or digging about the tree. Water must not be allowed to stand about the trunk or the soil remain continually saturated. After thus improving conditions, the tree itself may be treated by taking out narrow slits of bark on several sides of the trunk, extending from the ground up to the fork. These slits should pass through the gummy portion and also the unaffected bark. This will usually suffice to effect a cure if taken in time and if soil conditions are sufficiently improved.

Literature

Bulletins 200, 218, California Experiment Station.

Red Rot

A curing-house trouble in which the rind develops a rusty bronze color and gradually dries down into a sunken condition with a dark red or black color.

Cause unknown; apparently not a parasite.

Peteca

This trouble shows itself in the form of deep sunken pits in the rind of the lemon after it has been in the curing house for some time. The tissue at these spots is found to be dried and shrunken prematurely. The trouble is not serious, save in its effect upon the appearance of the fruit. Cause unknown.

Wither-Tip, "Tear Stain"

Colletotrichum gloeosporioides

The effects of this disease consist in a general way in a spotting of the fruit and leaves and killing back of the twigs, and an attack upon the young, newly-formed fruit, causing it to drop. Wither-tip is a trouble of quite common occurrence in Florida and probably most other citrus-growing regions. It has been known to exist in California for some time, but there has always been a question as to how much this fungus is really parasitic and how much it develops simply in a secondary manner upon tissues injured in other ways.

The most pronounced effect upon lemons attributed to the wither-tip fungus has been a slight spotting of the fruit, the spots being quite numerous upon the exposed side of the lemons while still on the tree, each spot of small size and reddish color. Such spotting has been quite generally attributed to this fungus, and yet it may be said that in numerous efforts made to produce such an effect by direct infection with the spores of the wither-tip fungus, entire failure has always been the result.

The fungus commonly shows itself to the eye in the form of numerous minute black dots upon the surface of dead twig tips or on dead spots on the leaf. In the latter case, starting on spots killed by fumigation, fire or other injuries, or possibly without preliminary injury on old, nearly dead leaves, the spots slowly spread in an oval form, with a yellow band between the dead and green tissue and the characteristic black dots *(pycnidia)* upon the surface of the dead portion.

Another fungus, a species of *Pleospora*, having a similar appearance and effect, has also been found quite abundantly on citrus trees in the northern part of the state.

The wither-tip fungus is one of the commonest inhabitants of our citrus trees. Every dead twig, every fallen leaf, every leaf or twig injured by fire or any other cause, immediately becomes covered with a flourishing growth of this fungus. Young lemons which fall to the ground from any cause show the same fungus upon them after a short time. It has even been found that the most healthy green leaves, if picked from the tree and placed in a moist chamber, soon become covered with this wither-tip fungus. Trees suffering from gum disease, gophers, drouth or any other influence which causes them to lose their vitality and begin to weaken and die back in the branches, soon develop an abundance of this organism. It is also likely that citrus insects, like the red spider and any other which punctures or injures the fruit, may promote the development of this fungus.

All in all, our conclusion has been that it is extremely doubtful whether the wither-tip fungus ever attacks sound, uninjured, vigorous foliage, twigs or fruit, or develops at all, save in a secondary manner or following some other injury.

R. E. SMITH,
California Experiment Station Bulletin 218.

LEMON PESTS

Chaff Scale
Parlatoria pergandii Comst

General Appearance

Small, circular, elongated, irregular scales with first exuviae near the side. Male scales are decidedly longer than broad. The color is a light gray.

Life History

Quite a prolific species which does not spread very rapidly. The breeding continues through the summer and fall months and the broods overlap as in the other armored scales. The trunk, large and small limbs, foliage and fruits are attacked.

Distribution

This species is limited to a few localities in California, having been imported from Florida.

Food Plants

Orange, lemon, *Japonica* sp. All parts of the plants and the fruits are attacked.

Control

Fumigation with full schedule No. 1. This is not a very difficult pest to combat.

E. O. ESSIG

Citrus or Greenhouse Mealy Bug
Pseudococcus citri Risso

General Appearance

Small mealy-coated soft-bodied insects, from one-fourth to three-eighths inches long and two-thirds as wide. They are specially characterized by a large amount of white waxy secretion covering the bodies. There are no perceptible wax tails or appendages.

Life History

The eggs are deposited in loose cottony masses by the females upon the food plants, mostly during the late fall and winter months. The young upon hatching move about very freely seeking suitable feeding places upon the tender foliage or young fruit. The females continue to move at will throughout their existence, but the young males soon spin a small white cocoon in which to pupate. Transformation requires but a short time, the two-winged males emerging when the females are about half grown. After copulation the males die and the females continue to develop for some weeks or months before egg-laying begins.

During the spring months the young are to be found in great numbers, but by summer they have so hidden themselves as to give the general impression that the pest leaves the trees during that period. In the fall the adults begin to deposit the large masses of eggs which make them more conspicuous. The entire strength of the female is converted into eggs, only the shriveled and dry skin remaining after all have been deposited.

The insect naturally hibernates during the winter in the egg state, but due to the uneven hatching caused by the warm weather in southern latitudes, practically all stages of the young and the adult

males and females may be also abundant during the winter months.

Food Plants

Works on a great variety of plants including the citri and cucurbits. The fruit as well as all tender growing parts of the plant are attacked.

Control

The control of this pest has been somewhat complicated and unsatisfactory, although at the present time considerable or complete success attends the efforts of careful work. Without doubt the best control measure is the application of a carbolic acid emulsion spray, which should be applied plentifully, from ten to fifteen gallons to an average size tree, and under a pressure of 200 pounds. We have found that two angle "Bean Jumbo" nozzles on a "Y" to each rod give best results. Large-holed discs should be used in the nozzles to insure a coarse driving spray.

If the mealy bug is present in great numbers it may be necessary to make two, three or even four applications a week or so apart.

During the winter, when there are large numbers of egg-masses, or in the spring when the young are hatching, is the best time for applying the sprays.

Fumigation has often given excellent killing results, but is not at all recommended for this pest, unless some other destructive scale insect, such as red, yellow, black or purple scale, is present and needs that treatment. Experience has shown that an excessive dose gives little better result than the ordinary black-scale dosage.

Silver Mite of the Lemon

Eriophyes oleivorus Ashm.
Phytoptus oleivorus Ashm.

General Appearance

The adult mites are so small as to be invisible except with the aid of a lens. They are light yellow in color, long and pointed anteriorly with two pairs of legs near the head. The eggs are exceedingly small, circular and faintly yellow in color. The presence of the mite is easily told by the characteristic silvery chafing of the skin of the lemon, due to the destruction of the oil cells. In Florida the oranges are also chafed, causing a russeting.

Life History

The eggs are deposited singly or in small clusters on the leaves or fruit. They hatch in less than a week in hot weather but require twice as long in cold weather. After several molts the mites become full grown in from two to three weeks. The young and adults feed upon the oil in the succulent parts of citrus plants, which is obtained by piercing the oil cells with their beaks. The adults are capable of rapid locomotion and move freely. They breed from spring until late fall, giving rise to many overlapping broods a year.

Food Plants

Works upon bark, foliage and fruits of citrus trees. In California its attacks are usually confined to the lemon.

Control

Same as for the citrus red spider. See *Apple Pests*.

E. O. Essig

Lettuce

Lettuce is a hardy annual, almost universally grown in American gardens, and is highly esteemed as a salad plant. It is generally grown out of doors from seed planted early in the spring, or it may be grown by a succession of plantings at different times during the year. It is not easily injured by early or late frosts.

Samuel B. Green, in "*Vegetable Gardening*," recommends the following:

Varieties

There are many varieties and each year finds many additions to the list of those offered by seedsmen. In the matter of quality, those forming a head like the cabbage have the preference. Varieties that form only a bunch of leaves are largely raised by market gardeners to supply the common demand, since they are more easily grown and are less liable to injury in handling than the heading varieties. Some of the most desirable kinds are as follows:

White Tennis Ball, or Boston Market

A very popular market variety adapted for hotbed and early spring use only. It forms a solid head of medium size but quickly goes to seed in warm weather.

Hanson

Forms large solid heads and is a general favorite; excellent for spring or summer use.

Black-Seeded Simpson

A popular forcing variety that stands well without going to seed and does not form a head but a mass of curled leaves.

Grand Rapids

A very desirable lettuce for forcing. It resembles Black-Seeded Simpson, but is a better shipping variety.

Black-Seeded Tennis Ball

A popular sort for forcing or early garden culture. It forms large, solid heads and is highly esteemed.

Salamander

A good heading sort for summer use.

Buttercup

Bright chrome yellow in color, very beautiful; tender and desirable. A popular new sort.

Lettuce is now being extensively grown in almost all the Northern and in some Southern states in hotbeds and marketed for winter use. Of late years this has grown to be a considerable industry. In this manner it is easily grown and the principal question is how to keep it fresh and crisp after taken from the hotbed and before it reaches the consumer. To secure this end the growing of lettuce in pots is sometimes resorted to. R. L. Watts, of the Tennessee Experiment Station, suggests the following advantages of pot culture:

Advantages of Pot Culture

1. The chief advantage is in making it possible to retain the succulent condition of the lettuce until it reaches the table.
2. Attractiveness of heads when offered for sale increases prices fully one-third on the Knoxville market.
3. The handsome appearance of curled varieties is highly appreciated by those who value lettuce for garnishing purposes.
4. It enables grocerymen to keep a constant supply of lettuce in a perfectly fresh condition.
5. It enables the consumer to keep a supply of lettuce to be used at will. This is a very important element, for cut lettuce should be eaten before it withers, and it is not possible by the usual method of marketing to keep the heads in a fresh condition more than a few hours.
6. A crop may be cut from the permanent bed every month when pot culture is practiced. With the usual methods a crop is cut from the same space about every two months during winter and spring.
7. Pots removed from the permanent bed when the plants are ready for market may be replaced at once by pots from the sandbed—a great economy of space.

The expense of pots and slight increase of labor in marketing are the only disadvantages, but we believe the advantages mentioned above overbalance the disadvantages and render pot culture desirable and profitable for gardeners depending upon local markets.

Size of Pots

It is not practicable to use pots smaller than two inches. Those exceeding three inches in size are too expensive and the balls are too large for convenient marketing.

Effect of Pots on Yield

The use of pots decreases the yield about 15 per cent. Plants grown with their roots thus confined are more compact but weigh less at maturity than plants set in open beds. Pot culture, then, is a disadvantage when lettuce is sold by weight or measure. The adoption of the system means a slight sacrifice in quantity for quality.

Value of Sodium Nitrate in Pot Culture

The decrease in productiveness when pot culture is employed is due to the confined and crowded condition of the roots. This difficulty can be almost entirely overcome by the application of con-

centrated commercial fertilizers at intervals during growth, provided potash and phosphoric acid are mixed in the soil when the pots and benches are filled. One application of sodium nitrate should be made while the pots are plunged in sand and two after they have been set in the permanent bed. Dissolve 30 ounces of nitrate in 25 gallons of cold water and pour half a pint of the solution around each plant. The effect upon the plants is remarkable. Growth is not only hastened but the foliage becomes darker and more healthy in appearance.

Varieties for Forcing

A great many varieties of lettuce are recommended for forcing purposes, but fortunately it is not difficult to decide upon a few that are entirely satisfactory for culture throughout the country.

Of the headed varieties, Boston Market leads. It is almost exclusively grown in the large establishments near Boston and New York. It makes a very solid, compact head that generally commands remunerative prices. Boston Market and other varieties of this class require very sandy soils to secure the best results.

Grand Rapids is a favorite with many growers. It is exceedingly hardy, upright and vigorous in growth and not liable to rot. The curled leaves form a beautiful head, rendering it especially desirable for marketing in pots.

Curled Simpson and Black-Seeded Simpson have been leading forcing varieties for many years. They have been used largely in hotbeds and cold frames. The heads of both varieties are more compact than those of Grand Rapids but not so handsome. Black-Seeded Simpson is larger than Curled Simpson and for this reason is the more profitable when grown to be sold by measure.

Adapted to Southern Conditions

Lettuce is an easy plant to grow and can be had at a season when most vegetables are scarce. There is such a demand for this plant that it is a luxury on many tables. Many of the varieties cannot stand the hot summer sun, but when given a little protection they may be successfully grown from September to June. The yield is influenced by the soil, but with careful management inferior soils may be changed to such a degree as to grow a satisfactory crop. The best soil for lettuce is a sandy loam, or loam underlayed with a good porous clay subsoil and one that is well drained. Without a clay subsoil much of the plant food will be leached out and lost. A deep sandy soil is quicker, but it must be constantly fed to produce good results, which makes it a soil very expensive to operate on. Care must be taken to select a soil that will not become water-sogged after a rain.

Lettuce is a quick-growing crop, and requires a large quantity of humus in the soil. Well-rotted barnyard manure applied to the soil is one of the best means of adding humus to it, but this is not always available. A good compost heap is another way of securing humus. The cheapest substitute for manure is the plowing under of leguminous crops. Lettuce growers should have their soil covered with a leguminous crop of some kind, when the lettuce season is over. Unless the grower is willing to give up the time and necessary expense to bring the lettuce soil up to the above requirements it will not pay to handle the crop.

Prepare the land by broadcasting stable manure or well-rotted compost and then plow it deeply. The land should then be harrowed until the soil is in the best possible condition. These preparations should be completed at least ten days before the time to set out the plants. About one thousand pounds per acre of the fertilizer given below should be applied to the soil and well incorporated with it before the plants are set:

Acid Phosphate (16%)	395 lbs.
Cotton Seed Meal	286 lbs.
Nitrate of Soda	125 lbs.
Muriate of Potash	194 lbs.
Total	1,000 lbs.

This is a 7-4-10 goods.

The above should be used in addition to manure. When the plants begin to head apply about 150 pounds of nitrate of soda per acre. An application of 75

pounds per acre should be made in about ten days.

Plants are ready for setting in about six weeks from the time the seeds are sown. If the weather is warm the seed may be sown in the open, but in case cold weather prevails the hotbeds or cold frames should be used. The seed bed should be made as carefully as possible, the soil being thoroughly broken up and finely pulverized with a good supply of well-rotted manure worked into it. One ounce of seed is enough for 2,000 plants and five pounds for one acre. The seed should be sown quite shallow in drills eight inches apart in the cold frames, firming the soil above them with a board. When planting the seed in the open the drills should be 18 inches apart. The seed does not germinate readily in warm weather, therefore it is better to shade the seed bed in the middle of the day to prevent it from drying.

When the plants are ready for transplanting weed out and destroy all diseased and feeble plants, as weak plants will not head. In transplanting avoid setting the plants too deeply, for if the base of the leaves is set in the soil the plants are liable to rot off or will not head. The plant should be set so that the bottom leaves will come at a level with the surface of the soil. As soon as the frames are set the beds should be well watered and shaded. When the plants have recovered from the transplanting the shade should be removed. The plants should be kept clean and frequently cultivated, also well watered. The early plants will not need protection, but after November sash should be placed over them at night. It is the practice of many growers to use cloth instead of sash. The cloth is cheaper from the standpoint of the initial cost but will cost more in the long run. The latter will last two years while the sash will last twenty or more if well cared for during the summer. A better quality of lettuce can be produced under glass and the moisture conditions can be more easily controlled.

There are two types of lettuce, namely, those that head and those which do not. The latter is preferred for the North Central and Western markets, while the heading varieties are preferred for Eastern markets. Both kinds are valuable for local markets and home use. The best varieties in each class are given below.

Heading—Big Boston, Hanson, Giant White.

Not Heading—Grand Rapids, Curl Simpson.

Lettuce is packed in seven-eighths-bushel hampers for shipment.

W. P. Williams

LETTUCE DISEASES

Bacterial Disease of Lettuce

The characteristic symptoms of this disease are so well marked that it need not be confused with any other lettuce disease. The edge of the leaves first turn brown, and later become dried and blackened. Also the leaves become first brown spotted, the spots afterwards turning black. Brown or black spots may be found along the midrib.

When the lettuce begins to head, the disease gets into the head and causes what is known as black rot.

The conditions which seem to favor the spread of the disease are warmth and wet weather.

The infection does not always take place in the field, but may be transmitted from the seed bed.

Suggestions as to Treatment

This disease can be spread through the field. Diseased plants should be taken off the field and burned. Do not pull up the diseased plants and put them in the alleyways.

As moisture and warm weather supply the conditions under which the disease thrives best, the beds should be kept thoroughly drained. Do not let the covers down at night unless you are sure there will be frost, and raise them early in the morning as soon as the atmosphere is warm enough. Be sure and plant the seed bed where there were no diseases the previous year. Do not set out any plants from an infected seed bed.

O. F. Burgher,
Florida Experiment Station.

Damping Off
Corticium vagum

This trouble is caused by a soil fungus frequently called Rhizoctonia and known technically as *Corticium vagum.* This fungus, which is widespread, is capable of causing damping-off diseases in many different kinds of seedlings and plants. In its attack on lettuce it may either "damp off" the young seedlings at the surface of the ground or, if it attacks older plants, it may produce the rosette. This condition is characterized by the failure of the center leaves to grow.

Control

Either steam sterilization of the soil or a treatment with formalin has been found effective. In sterilizing with formalin, use a 5 per cent solution of the 40 per cent formaldehyde in water and drench thoroughly. Allow soil to dry before setting plants.

Downy Mildew
Bremia lactucae

This disease is caused by a fungus which in its life history is similar to the fungus causing the onion mildew. This disease occurs, in general, only under certain conditions favorable to the growth of the fungus. It occurs in the greenhouse or in forcing frames which are kept too warm or moist and may ordinarily be controlled by properly regulating these conditions.

Symptoms

It is recognized by yellow areas on the upper surface of the leaf and by the white downy growth of the fungus on the lower surface.

Control

It is advisable to burn diseased leaves or plants and water the beds in such a way that the foliage is kept dry.

Drop
Sclerotinia libertiana

The fungus causing this disease occurs on many different kinds of plants, and since it is a common soil organism of a type that is hard to control should be carefully guarded against. The affected plant shows no definite diseased spots. It grows slowly, finally the stem and lower leaves become watery and soon the whole plant collapses and rapidly decays.

Control

It is claimed that the disease can be eradicated from a bed in two years if all diseased plants are removed and destroyed as soon as they appear and the place is immediately drenched with Bordeaux mixture or a solution of bluestone. This is necessary in order to prevent the sclerotia or resistant stage of the fungus from maturing. In some cases it may be easier to change or sterilize all of the soil in the bed. The disease can be held in check by the careful regulation of temperature and water supply. A low night temperature with constant day ventilation is very essential.

Gray Mold
Botrytis cinerea

This disease is due to a common fungus and is in all essentials like the drop. After the plant has collapsed, a gray mold appears and at this stage great numbers of spores capable of spreading the disease are produced. The same control measures apply as for drop.

Leaf Perforation
Marsonia perforans

This disease has recently been found in greenhouses in several localities in the Northwest, and as it has caused considerable damage in Ohio, where it was first discovered, it seems advisable for the growers to be on the lookout in order to hold it in check.

Symptoms

On the leaves this fungus causes spots which die and drop out. On the midrib, many sunken, elongated spots are produced. A plant once affected seldom ever recovers and the new leaves are misshapen and unsalable.

The spores of the fungus are often scattered by watering or air currents. They are produced in great numbers on the spots of dead leaf tissue which fall out.

Control

It is claimed that Bordeaux mixture can be used in the seed beds and on seedlings to keep the disease down, but if

infestation becomes serious, thorough fumigation of the houses and soil sterilization will be profitable.

F. D. Bailey

Leaf Spot

Septoria consimilis E. & M.

The leaf-spot fungus is frequently upon wild lettuce plants and occasionally upon outdoor lettuce, especially in late seasons. The small characteristic leaf spots are not difficult to distinguish from anthracnose. The remedies are confined to avoidance.

Tip Burn

Tip burn of lettuce leaves is often brought to notice. Usually it is associated with unsatisfactory watering in the greenhouse, or with extreme changes to summer weather. The remedy consists in the methods of watering employed.

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Lettuce Culture in Alaska. See *Alaska.*

Lime

The lime, *Citrus medica*, is a small tree of the orange family. Its fruit resembles the lemon in appearance and character but it is much smaller and is not so extensively cultivated because not so generally in demand.

There are two varieties, the sour lime, *var. acida*, and the sweet lime, *var. Limetta.* The juice of the lime is acid tonic and considered a preventive of and remedy for scurvy.

The sailors of the British navy are sometimes called "lime juicers" because the law requires that the crews be furnished with a weekly allowance of lime juice or lemons as a preventive of scurvy.

Varieties recommended for the districts where grown:

(For *Map of Districts*, see page 192.)

District No. 6

Highly recommended—*Dessert, Kitchen and Market:* Rangpur.

Recommended—*Kitchen*: Turanj.

District No. 17

Recommended—Mexican.

District No. 18

Recommended—Imperial; Mexican.

LIME DISEASES AND PESTS

For the most part the lime is attacked by the same diseases and pests as attack lemons and oranges, which see.

Diplacus Ceroputo

Ceroputo yuccae Coq.

General Appearance

This insect is continually mistaken for the regular mealy bugs belonging to the genus *Pseudococcus.* It differs in having a tooth on the inner surface of the claw, and a row of spine-groups on each side. The cottony covering is very dense and arranged in broad segmental plates. The males are nearly half an inch long, with dark and orange-colored bodies, and long anal filaments. The cocoons are elliptical in shape, white in color and scattered among the females.

Life History

The young are born alive and soon secrete wax enough to completely cover them. The broods appear in the late spring and early summer, and are especially abundant during the months of April, May, June and July. The males mature when the females are about two-thirds grown; the life period of the females being from three to five months. This species lives under the ground on roots of black sage, *Ramona stachyoides*, and above ground on other plants. As an aerial form it does not appear until late in the season. The adults in all probability hibernate under ground in winter.

Food Plants

Black sage, banana, orange, lime.

Natural Enemies

Coquillett bred an internal parasite from specimens taken in Los Angeles county. This he named *Blastothrix yuccae* Coq.

E. O. Essig

Liquid Manure Tank

Liquid manure tanks, which can be built at a very small cost, have proved their worth not only by improving the sanitary conditions around the barns but by benefiting the soil. The first one erected in Pierce county, Washington, cost $100. The tank is built of concrete and coarse gravel, the walls being 8 inches thick. The tank may be built any length to suit the dairyman. One of the most successful ones in Tacoma is 65 feet long, 16 feet wide and 7 feet deep.

All of the urine and manure from the dairy is run through pipe connections to the tank together with about 60 per cent of water. When opportunity comes to put the liquid manure on the soil, it is necessary to empty the water-tight tank by means of a pump into a tank wagon with low wheels. Or if the tank is built on a side hill, a pump may not be necessary. A perforated pipe is built on the rear of the wagon, extending about 2 feet on either side of the wheels. The perforations are about a half inch in dameter, and the pipe is about 4 inches in diameter. By means of a lever, the driver can regulate the flow.

The concrete tanks ought to be constructed about 50 feet from the barn, and if possible so situated that it would only be necessary to drain the fluid from the receptacle into the wagon.

By means of a screen any obstacle that will tend to clog the perforations in the pipe on the rear of the wagon may be eliminated. It has been found that the urine is just as valuable for fertilizer as the manure, and the liquid fertilizer is much easier to handle.

Dr. S. A. Rhoades,
Tacoma, Wash.

Loganberry

The loganberry is a hybrid originated by crossing the Red Antwerp raspberry with the Aughinbaugh blackberry. It has come to be regarded as of considerable commercial importance and is regarded by many fruit growers as one of the most profitable fruits.

LOGANBERRY CULTURE IN THE WILLAMETTE VALLEY

Britt Aspinwall

Used by special permission of the Pacific Horticultural Correspondence School, Portland, Oregon

Before going into the loganberry business on a commercial basis it is important that that the following requisites be observed:

(1) Selection of soil, (2) proper drainage, (3) right proportions for yard, (4) camping facilities for pickers, (5) protection from frosts, (6) shipping facilities, (7) wood, (8) good plants.

Selection of Soil

(1) I prefer a deep, rich, dark loam soil; bottom land is usually richer than upland, especially the silt soils near the rivers, but as much of it has a gravelly subsoil it is harder to keep the moisture near the surface by cultivation than on the upland prairie soil. Loganberries do fairly well on the red hill land but not so well as on black loam.

Proper Drainage

(2) Drainage is very important, as loganberries will soon die out where the water stands around the roots for several days at time. As the rows should run north and south it is best to select land that drains either to the north or south, if surface drainage is used, so the water will run off between the rows during the winter. If there is not good surface drainage, or if it drains to the east or west, the land should be tiled.

Right Proportions for Yard

(3) This is a point that is many times overlooked. I have seen loganberries set out with the rows from 40 to 60 rods long, making it unhandy in every way about picking and carrying out the berries. We find that rows from 45 to 50 hills long are the most convenient in picking, as it gives the pickers only a short distance to carry the berries to the ends of the rows. We always set them out leaving a 16-foot road through the middle, and rows of the above length on each side of the road, so as to build the packing sheds and evaporators in the middle of the yard and work across the

road so as to save as much turning as possible with the teams.

Camping Facilities for Pickers

(4) This is important in every large yard where pickers have to come and camp. It is much easier to get pickers to come where they have a good place to camp in the shade, as the picking season is during the hottest part of the year when families are glad to get out of the cities and camp out. Convenience to the yard, good water and dry wood are all important in getting and keeping pickers.

Protection from Frosts

(5) The ordinary precautions observed in selecting a site for an orchard should be taken here. Where a yard is protected by trees it is less apt to freeze during a hard winter or late spring than in the open.

Shipping Facilities

(6) This is important, especially if the berries are to be shipped fresh, as hauling them over rough roads makes them settle and bruises them so they will spoil sooner; besides, it is considerable expense to haul for several miles to a shipping point. It is much more convenient to get pickers when near a station, as they usually come a few at a time for several days until the berries get ripe enough to keep a full force busy picking them.

Wood

(7) Wood on the place is important if the berries are to be evaporated, as it requires about a cord or a little more for each ton of evaporated berries. It is also necessary to have wood for campers to burn.

Good Plants

(8) It is almost impossible to make a success of raising loganberries without good plants to start with. It is important that they have good roots and are set out without becoming wilted or heated. There are two kinds of plants sold, viz.: eye or bud plants and tip plants, which are obtained by burying only the tip end of the vine, in the fall of the year. These make a much stronger plant and are the only kind that should be set out. Transplants are young plants that are nurseried out in the spring of the year and have one year's growth; but I prefer a good tip plant to anything else as it is not stunted by being grown one year in a row too crowded, and when once started the roots are not disturbed. If it is practicable the plants should be dug with a little dirt on the roots and set out as soon as possible. Where good plants are not obtainable close enough so they can be hauled they should be packed in good condition so they will neither heat nor dry out before arriving at destination. Where shipment is made for some distance transplants are preferred by some growers.

Preparation of Ground

For the best success the ground should be plowed in the fall and again in the spring and thoroughly worked up and put in the best of condition. Do not try to rush matters and work the ground after the plants are set out, but get it in good shape first. The fall plowing should be from 10 inches to a foot deep and in the spring about six or eight inches deep. After it is all prepared in good condition, mark both ways with a marker, making the rows eight feet each way and set out where they cross. This is the fastest way, as one man can dig holes with a shovel for about five to set out, setting out in good condition about six acres a day. Some use a wire for lining up the rows, which is a good plan on a small yard but is much slower.

In setting them out take a good shovelful of dirt out and put the plant in, spreading the roots out in good order and packing the dirt in around them by hand, so as to keep them from drying out. After the plants are set out they should be worked both ways during the first summer once each week with a disc harrow or spring-tooth, followed by a clod masher when the weather is at all dry.

It is best never to try to raise anything between the rows the first year, as it is harder to cultivate during the summer, and in harvesting the crop the vines are usually injured to considerable extent; besides scarcely any two crops need cul-

tivating at exactly the same time. The vines will not make much of a growth until about the first of August, when they will shoot out over the ground making vines sometimes 20 to 30 feet long before the first of October. As soon as the vines begin to grow out in the way, so as to bother with the cultivation, they should be turned lengthwise of the rows and the ground cultivated only one way. Then is a good time to commence setting the posts in the rows so as to get them all in and the wires up before the first of October, when it is best to train them up.

In setting the posts use good strong posts, preferably cedar, seven feet long, and set them not over 32 feet apart in rows and two feet in the ground. This makes a five-foot trellis. Three No. 12 galvanized wires, placing them 20 inches apart with the last one on top of the posts, are used. The end posts should be anchored good, as there will be a heavy strain on the wires when the vines are loaded with ripening fruit or during the winter if they get covered with snow.

The cost per acre for setting out loganberries, figuring labor at $2.00 per day, is as follows:

Cost of plowing (twice) and fitting land	$ 6 00
Cost of setting 680 plants (each man one acre)	2 00
About 180 cedar posts at 10c........	18.00
500 pounds galvanized wire at 3c....	15 00
Digging holes and anchoring end posts	5 00
Hauling in and setting posts........	3.00
Stretching wire and stapling..........	3 00
Dead men for anchoring and staples...	1.00
	$53 00

Of course this will be increased by an advance in the price of posts, wire or labor, or on the other hand decreased by a decline of prices, but I think it is a fair estimate of the average cost. The cost of plants will vary in different years and will also be governed as to whether tips or yearling transplants are used.

Training the Vines

The first year the vines should be trained upon the wires the latter part of September or during October. In training them up the first year a number of the shorter canes will have to be tied to the wires to keep them up, but after the first year they can be trained without tying by wrapping them around the wires. In training spread the vines out covering as much space as possible and avoid bunching them on the wires, as it will bother in picking the berries if the vines are bunched. The top wire will carry most of the weight and we run the vines out on this wire and the second one, turning the ends down just enough to hold them good unless more plants are wanted, when they will have to be trained with the tips down to the ground so they can be covered in the fall.

To secure plants from the vines train them with the tips to the ground and cover about three inches deep about the first of October. They will take root in the fall and make good strong plants for setting out in March or April. They may be covered by plowing a furrow to them, if the tips are nearly even, or with trowels.

Cultivation

After the vines are all trained up in good order the land should be plowed, throwing the dirt to the vines. Plow the first two rounds with one horse on a vineyard plow and the last one should be made with a team on a heavier plow. Next to the vines it should be plowed shallow so as to not injure the roots, but the dead furrow in the center should be quite deep so as to afford good drainage during the winter. Leave the ground in this condition without harrowing until spring. In the spring of the year as soon as the land is in good condition to work, plow it, throwing the dirt to the center of the row. The last furrow should be shallow and close to the rows so as to save as much hoeing as possible. Follow the plow with a harrow to keep the ground from drying out, then hoe out all the weeds in and between the hills. This may be done either by hand or with a horse hoe. The horse hoe is more practicable in a large yard as it saves considerable time and expense. After hoeing follow up with a disc harrow, throwing the dirt toward the vines, leveling it down. After this keep it worked during the summer with a disc harrow and spring-tooth harrow or something

similar once each week, followed each time with a clod masher to keep a dust mulch on the surface. They should be worked up till about the middle of July and the last time should be gone through with a disc harrow to throw the dirt up to the rows and between the hills so as to keep them from drying out.

Picking

Picking season will start in about the 20th of June, but it is sometimes a week or ten days earlier or as much later. It will last about six weeks. If the berries are to be shipped to the market fresh they will have to be picked very firm, but if they are to be evaporated they must be left on the vines until fully ripe as they will dry heavier and make a better fruit if fully ripe.

It requires about five good pickers for each acre. Everything should be in readiness before picking starts, plenty of wood and water for the pickers, carrier for picking into, etc. A good yard boss is also very important. One who knows just how the berries should be picked and can get along with the pickers is the kind to have. He must be able to get through the yard several times a day. The rows should all be numbered so the yard boss can keep a book of just which row each picker is on and know who is responsible if any berries are skipped. If they are to be shipped to the cannery or to the market fresh, a good packing shed should be provided in the center of the yard so as to make it convenient for the pickers to bring in the berries.

The cost of picking is about $20 per ton of fresh fruit. Pickers are paid 5-6 of a cent per box for the first two weeks of picking, 1 cent per box for the next two weeks and 1¼ cents for the balance of the season. As the berries are a little thinner at the last of the season than at the beginning this makes an average price of about 1 cent per box. This method of paying gives the pickers who stay through the season as good pay as though they received a cent a box straight through, but those who quit after picking a few days get less pay for what they have done and any that have to be engaged later in the season get more pay as the berries get thinner on the vines. Each picker is numbered and has a ticket with a place for the picker's number at the top and figures running from one to 12 down through the center with the grower at the bottom. The check men punch out the number of boxes picked, giving a new check with only one hole punched each time. Three colors are used, one for each price paid for picking. Each color is also marked whether 5-6 of a cent, or 1 cent or 1¼ cents per box. The check man puts the picker's number on each ticket with an indelible pencil. We also number the carriers, so we can at any time check against the picker by keeping tab every few days when dirty berries are found.

Pick in the common hallock, either square or good tin tops, and use carriers to hold 12 of them. The carriers should be as light as possible and have tight bottoms. Use ⅞-inch stuff for the ends and ¼-inch for the sides and bottoms. If they are built with the end pieces 5 inches high and the handles about 9½ inches high they will easily stack up as well as when crated, which is very important when they must be piled on the platform of the dryer so as to have enough to run through the night. When evaporating the berries there should be at least four carriers for each picker, but when they are to be packed and shipped fresh two will do, as they are emptied much faster and none have to be left for storing the berries for night work. We use two-wheeled spring carts with a bed large enough to pile 12 carriers on the bed and as many can be piled on top as can be handled. The check men take this cart up the road through the center of the yard and load on the berries as fast as brought to the ends of the rows, giving checks for them; when loaded they return to the evaporator or packing shed and unload, loading up with empties while the other one is being loaded. This keeps the pickers in the yard out of the way, and two men

can handle the berries for 100 or 125 pickers in this way if everything is convenient. In large yards of 100 acres or more the hauling could probably be done better and cheaper with a flat-top spring wagon or an auto truck.

A good average crop of loganberries, taking it one year with another for several years, is about four tons or a little more of fresh fruit to the acre, although with proper care on good land they frequently yield as high as six or seven tons.

Evaporation

There are several kinds of evaporators, but I prefer either a stack or tunnel dryer. A good stack dryer with a good lift is very good and will give good service, but is more expensive than a tunnel dryer.

There are many different styles of tunnel dryers built, but unless one knows just what kind he wants he should get an experienced man to make the plans and build it, as it is necessary to get them about right to get the best results. It requires about 30 trays 25x42 inches to handle the berries from an acre of land. The trays should be made of 4-mesh galvanized gray cloth and be well braced to keep them from sagging. Three or 3½-mesh cloth will do, but if the finer mesh can be obtained it will be more satisfactory. It requires from 20 to 30 hours to dry loganberries with the heat at about 140 degrees. A man who understands the business should be in charge of the drying, as it is an easy matter to spoil several dollars worth of berries in a very few minutes' time. After the berries are evaporated they should be binned in a dark bin and shoveled over each day till they do not pack any more or they will pack and mold.

It requires from 5 to 5¾ pounds of fresh loganberries to make one pound evaporated, depending largely on the condition of the fruit when picked. If it is a little green it will take more pounds of fresh fruit than if fully ripe when picked. The cost of evaporation is variously estimated at from $30 to $75 per ton of evaporated fruit. Of course it depends largely on the size of the evaporators and the amount of fruit handled, but I believe the cost for evaporating in a yard of 20 acres or more can be reduced to $40 per ton or lower by running a double 12-hour shift, using three men in the day and two at night. It would probably require a little extra help some days during the busiest part of the season and less help to wind up with.

The daily output from a 20-acre yard will average about 1,000 pounds of evaporated berries daily, of course running considerably more during the heaviest picking and less during the fore and latter parts of the season. It takes a little over a cord of wood to the ton of evaporated fruit, and the man in charge of the drying for each shift will probably ask about $4.00 per day of 12 hours and the other help can usually be had for $2 00 or $2.50 per day. We run our shifts from midnight till noon, except the regular day help.

The cost of a good stack dryer for a yard of 10 acres would be about $1,000, depending, of course on the kind of building put up and cost of material, and a tunnel dryer would be probably $200 less. For an acreage of 15 acres or more I would recommend a tunnel dryer, as the cost is considerably less and the cost of handling the fruit is also less. The cost of a tunnel dryer for an acreage of 20 acres or more can be figured at about $50 for each acre of berries. A dryer with 10 34-foot tunnels should handle 50 acres if the tunnels are built with a drop of 1¾ or 2 inches to the foot and with a good draught.

Pruning Vines

As soon as the picking season is over and the old vines are ripe they should be cut off at the ground and pulled out, throwing them between the rows where they can be cut up by running over them several times with a sharp disc harrow. As soon as the old vines are out the new ones should be trained up on the wires ready for the next crop. If this is done soon after picking it is much easier, as

the vines grow fast in the fall of the year, and the sooner it is done the fewer vines there are to handle. If the vines are to be tipped they should be trained down within about 12 or 14 inches of the ground so they will grow about the right length before tipping, but if no more plants are wanted they should be run out on the wires. As soon as they are trained the old vines should be cut up ready for the land to be plowed after the first rains in September.

The cost of cutting out the old vines and training up the new ones is about $12 per acre each year if done the first thing after picking. If they are left for some time afterward the expense will be considerably more owing to the extra growth the new vines have taken on. One of the most important things in connection with loganberry culture is the cutting out of the old vines. This should be done as soon as possible after the picking season is over, as they are taking the strength out of the roots that should go into the new vines for the next year's crop, and if there is any disease in them it is spreading to the new vines. If they are taken out early and disked up in the rows I think there is very little danger of any disease spreading from them, and they make a good fertilizer. Some growers have resorted to spraying their vines for anthracnose, but a close inquiry reveals the fact that the new canes were left lying on the ground during the winter, where they are far more susceptible to disease than when trained up on the trellis. The cost of spraying is said to be about $1 per acre when put on in good shape with a power sprayer. As stated before, however, if the vines are cut out as soon as possible after picking, and the new ones trained upon the trellis so as to disc up the old ones and plow them under, I think there will be no need for spraying for several years to come. Some growers are also taking the old vines out and burning them, but I think this is a mistake and an unnecessary expense.

Most of the land in the Willamette

Loganberry Field, Showing Method of Trellising.
—Courtesy Southern Pacific Railroad Co.

valley will raise loganberries if they are properly handled, but unless they are to be well cared for they had better not be set out at all, as a little mismanagement in the work, such as not setting them out when the ground is in the best of condition, or working them at the proper time, will result disastrously and it requires only a few days to set them back a great deal. Unless one has had experience he should get some experienced man to handle his yard the first year at least, if he goes into the business very extensively. It requires good judgment to grow loganberries the same as it does to make a success with an orchard, and as every season is different no one rule will work every year.

There is at the present time a great and growing demand for canned and evaporated loganberries, besides for the juice, and as the Willamette valley is the most ideal place that can be found for their culture it promises well to be one of the leading horticultural industries here in the future.

When loganberries are shipped to the market fresh they seem to sell best in the 24-box double crates. These cost about 15 cents each, including crates and hallocks. They should be packed with care, being careful not to set the top boxes on any of the berries in the lower ones so as to bruise them and make them leak, as they will present a very unsightly appearance when they arrive at destination if bleeding much. In packing them it is not necessary to face them as in strawberries, but see that the boxes are well filled and put into the crate properly.

Evaporated berries are packed in one-pound paper boxes with 24 or 36 to the case, and in bulk in 10, 25 and 50-pound boxes. The trade apparently takes to them better in bulk than in the one-pound boxes. The cost of boxes, waxed paper for lining, and labor in packing in bulk is about $40 per ton for the evaporated berries.

LOGANBERRY JUICE

C. I. Lewis,

No phase of horticulture on the Pacific coast has attracted so much comment, and favorable comment, the past two years, as the loganberry, and the rest of the nation has been aroused to the true merits of this berry. We are realizing that we have a new food, so to speak.

The merits of the loganberry have been realized largely from the fact that it could be canned successfully, and made a most excellent pie; that it could be easily evaporated, and that it made a most excellent jelly. Not until recently, however, have we realized that probably the greatest asset was its juice.

Loganberry juice is being pronounced by experts wherever tried as superior to grape juice. We know that a wonderful business has been built up in the manufacture of grape juice. It would seem, therefore, that a splendid opportunity is presented to Pacific coast growers in the manufacture of loganberry juice.

This beverage is very refreshing and healthful, easy to manufacture, and easy to keep. The organic acids of the loganberry seem to be very largely self-preservative, much more so than those found in any other berry. The manufacture of loganberry juice is as yet in the experimental stage. It is being manufactured almost entirely for home use, there being but a few firms who are attempting to manufacture it commercially, and the next few years should demonstrate to us the proper technique to employ in the manufacture of the juice.

Experiments will demonstrate the real value of the loganberry as a commercial asset.

In considering the loganberry juice I would make three divisions: First, beverages for home manufacture, or to be sold in bottles for home consumption. Second, a syrup for soda-fountain trade in the East. Third, special concentrated juices for the use of caterers.

All three of these fields are very large and any one of them could be made to use the juice from a large acreage.

Home Manufacture of Juices

The simplest way to make loganberry juice that we have ever tried is the following: Place just enough water in the bottom of a kettle to cover the loganberries. Heat nearly to the boiling point, but do not allow to boil. Stir them occasionally and crush them if possible. After they become soft strain the mixture through a cloth jelly bag. Allow the mixture to drip thoroughly, putting the juice back on the stove and adding one-third sugar by measure. Again heat the juice up to about 200 degrees and bottle. Drive in the corks tight and cover with paraffin. Such juice can probably be kept indefinitely, as I have kept it at least two years. This is a heavy juice and will need to be greatly diluted before drinking. From one-half inch to an inch of this juice in the bottom of a glass of water is a beverage of sufficient strength. In making punches the addition of the juice of four lemons to each gallon adds to the quality.

Recipe No. 2. This is being used by a grower in Southern Oregon. The juice is made very largely as Recipe No. 1, except that before final bottling the juice is allowed to stand for about nine days, when it slightly ferments and has the snap of sweet cider after it begins to work a little. Some people prefer a beverage of this nature.

Recipe No. 3. This to put up the juice absolutely without any cooking. To do this a fruit press should be used to extract the juice. All bottles and utensils used should be sterilized. This is not the best process for the average person to use as most of the juice will spoil.

Recipe No. 4. Heavy syrups. Caterers who have made punches find that if instead of adding one-third of the measure of sugar, we add about eleven pounds of sugar to each gallon of juice that a very heavy syrup results; that the sugar tends to set the flavor of the berry and that this amount of sugar tends to result in a better flavor than where a small amount of sugar is used. It is claimed by some that this preparation will keep without cooking. When this is diluted it makes a most excellent punch, especially where the juice of about four lemons is added to the gallon of the liquid.

Commercial Manufacture of Juices

The commercial manufacture of loganberry juice is in its infancy. Little information as to the amount of juice which can be obtained from an acre is obtainable. One man has reported that he has obtained 90 per cent juice. If this is so the average yield of juice from an acre would be tremendous. The commercial manufacture of loganberry juice would be very similar to that of apple cider and grape juice. The machinery, etc., used in making sweet apple juice, or carbonated apple juice, would be applicable to the manufacture of loganberry juice.

Of course you must use great care to have all the buildings and all instruments sterilized and to keep the juice in cold storage after bottling. Probably a small amount of cooking, sweetening and bottling, much along the lines indicated in Recipe No. 1 for home use, would be one of the principal ways for utilizing loganberry juice. Those who like a carbonated drink could very easily carbonate the juice. For shipping east in all probability the best line for us to experiment along will be that of making heavy syrups, that we can ship in barrels or kegs and have the eastern people either bottle this for the soda-fountain trade or for caterers.

For a method for holding berries for soda-fountain trade, see *Method of Holding Fresh Berries*, under *Storage*.

LOGANBERRY DISEASES AND PESTS

The loganberry is attacked by much the same list of diseases and pests as the related raspberry and blackberry. The diseases and pests of loganberry will be found listed under the above plants.

FROSTED SCALE. See *Apricot Pests*.

Louisiana

Louisiana is one of the largest and one of the most important of the Southern states and has the most important seaboard city of the South. It was said by Napoleon Bonaparte that whoever held New Orleans held the key to North Ameri-

ca. The Mississippi river, with its immense volume of water, flows in a winding way along the western border of the state for a considerable distance, then across the southeastern corner of the state, leaving 37,000 square miles on the west side of the river and 4,346 on the east. This river flows through alluvial soils of low elevation, requiring the protection of levees, of which there are 1,500 miles. The coast line of the delta and eastward consists of lands little above sea level, intersected by small tracts of elevated prairies and low ridges covered with live-oaks. North and westward the land rises until in the northern part of the state the hills attain a height of 500 feet.

The entire state was formerly an ancient gulf whose shores at one time touched Cairo, Ill., which has been gradually filled in by the deposit brought down by the Mississippi.

The climate is semi-tropical. In summer the mercury reaches 105 degrees. In winter it seldom drops far below the freezing point, but occasionally there are heavy snows, and in the winter of 1895 the mercury fell to 9 degrees above zero. This being 23 degrees below freezing point, great damage was done to the crops and especially to the orange groves. This, of course, was extreme and does not occur once in a generation, but the mercury often falls to the point of danger. The prevailing winds are from the ocean and Gulf, which for the most part furnishes protection from the cold. The rainfall varies from 40 to 60 inches, according to the location.

Less than two-fifths of the land area is under cultivation and the principal crops are sugar-cane, cotton, corn and rice. Judging by the ease with which the fields could be irrigated from the river beds that are higher than the surrounding lands, it is possible that Louisiana may in the future produce enormous quantities of rice. The sandy hills of the uplands in the northern part of the state will successfully grow apples, peaches, pears, plums and cherries that are selected with reference to a southern climate, but it is too far south to grow the best-keeping varieties of apples and place them on the market in competition with those grown in the northern sections. Further south in the central portion of the state are the bluff-lands that produce peaches, plums, berries and immense quantities of vegetables. In the Gulf region lemons, oranges, persimmons, figs and bananas are grown successfully. However, it should be borne in mind that there is danger from what is called northers, or cold waves. Hundreds of acres are planted to strawberries in all parts of the state and this fruit is shipped in carload lots to the northern markets, where it brings very profitable returns.

Soil

* The bluff soils of Louisiana are not friendly to all fruits. Being tenacious of moisture as well as highly fertile, some of the soil tends to produce excessive vegetation rather than heavy fruiting.

The fruits belonging to the more temperate regions do not possess full hardiness so far as Louisiana conditions are concerned. They become weakened by climatic influences and soon become a prey to various insect and fungus attacks.

Another serious drawback is the uncertain character of the seasons. An open winter may induce very early blooming and subsequent frost will then kill the fruit. Measures adopted in Northern states for retarding the blooming period are not applicable here.

Another source of trouble is the tendency of some trees to overbear. This no doubt is the most prominent cause of the early death of some trees. The only remedy for this is to thin the fruit thoroughly and systematically, a thing that very few people, outside the commercial orchardists, ever practice.

To meet losses sustained, it is necessary to plant some fruit trees every year, so that as they bear and commence to fail, new trees will come into bearing and supply plenty of fruit.

*Bulletin No. 112, Agricultural Experiment Station, Baton Rouge, La.

Cultivation in the Station orchard has consisted in keeping the orchard as clean as possible, and no fertilization has been given except an occasional crop of peas. Frequent use of the cultivator, and plowing when necessary, has accomplished this fairly well. In the rainy portion of the summer it has been difficult to follow, and it is probable that some injury may have resulted by later cultivation, which seemed to be necessary.

GRANVILLE LOWTHER

Frost and Precipitation in Louisiana

Station	Frost				Precipitation
	Average Date of		Date of		
	First Killing in Autumn	Last in Spring	First in Autumn	Last in Spring	Annual inches
Shreveport...	Nov. 11	Mar. 4	Oct. 20	April 2	46.1
Monroe.............	Nov. 7	Mar. 15	Oct. 10	Mar. 29	47.5
Lake Providence ...	Nov. 8	Mar. 14	Oct. 15	Mar. 30	50.9
Alexandria..........	Nov. 8	Mar. 12	Oct. 19	April 9	54.9
Melville..............	Nov. 3	Mar. 12	Oct. 10	Mar. 29	53.6
Baton Rouge..	Nov. 21	Feb. 28	Oct. 27	Mar. 20	54.6
Amite...........	Nov. 6	Mar. 16	Oct. 19	April 1	60.1
Lake Charles..... ...	Nov. 28	Feb. 24	Nov. 4	Mar. 29	53.3
New Ileria.....	Nov. 30	Feb. 24	Nov. 3	Mar. 20	53.7
New Orleans.	Dec. 15	Jan. 24	Nov. 11	Mar. 27	57.6
Port Eads.............	Dec. 20	Jan. 26	Dec. 5	Mar. 17	55.2

LUELLING, HENDERSON. See *History of Orcharding in Old Oregon*, under *Apple*.

Maine

The surface of the state of Maine is gently rolling, forming a part of the "New England Uplands." Above these uplands rise isolated mountain peaks and clusters of peaks from 3,000 to 5,200 feet in height in contrast with numerous river valleys, level uplands and lakes, making a setting of beautiful scenery, which, together with its cool climate, invites many summer visitors with tents, cottages and summer homes to many parts of the state. The needs of this summer population have given a new impulse to market gardening and horticulture, especially of the varieties of fruits adapted to the summer markets.

Geologists say that there was a period of general uplift which caused the rivers to cut below the general uplands and developed well-marked valleys for themselves. Then came the period of great continental glaciation. The glacier or ice sheet overran all Maine, irregularly scouring out the bedrock to produce rock basins, damming up many river valleys with glacial deposits and completely disarranging the drainage lines. This is the origin of the numerous lakes in Maine, the largest of which is Moosehead lake of about 120 square miles, making possible the production of fruits which would otherwise be too tender for that latitude.

The principal commercial fruit of Maine is the apple, of which, according to the census of 1910, there were 3,476,616 trees. The census of 1900 showed 4,184,781, showing a decrease in the number of trees of 708,165.

The counties producing the largest number of bearing trees are: Oxford, 444,529; Kennebec, 409,593; Androscoggin, 376,746; Franklin, 374,464; Penobscot, 283,223; Cumberland, 269,658; Summerset, 258,985; York, 237,242; Waldo, 206,251.

Of peaches and nectarines there are reported for the state 5,102 trees, of which York county has 3,068.

Of pears there are reported for the state 46,683; plums and prunes, 43,561; cherries, 2,403, and grapes, 9,731 vines.

The total number of acres of small fruit is 1,260, distributed as follows: Strawberries, 698; raspberries and loganberries, 127; blackberries and dewberries, 145; cranberries, 151.

Mr. G. M. Twitchell, president of the Maine State Pomological Society, says:

"Maine is a natural apple-growing state and trees spring up wild in every locality. This being so, the first thought with the future orchardist will be to avail himself of the strength, vitality and enduring power of selected native stock. If this leads to the establishment of nurseries in Maine, a long step will be taken towards results now impossible. Supplied as the farms through the fruit section are so generally with bearing trees, I am forced to the conviction that before we urge further increase we should emphasize better treatment of what we have. The man who fails to care for his old trees will never give proper attention to a new orchard. The steady increase of pests and diseases, brought here largely on fruit stock, forces attention to the trees now standing and their protection in every way possible. Beyond this there is call for an organized movement to cut down and burn every worthless tree or those so situated as to be of no earning value. These harboring spots for all pests and disease spores must be reduced to the utmost that the cost of protection to growing orchards may be minimized. It is desired that this end be reached without drastic legislation, but the protection must in some way be insured. The development of the industry outweighs the wish of any individual and must be the sole standard. The apple industry is worth to Maine from two to three million dollars yearly. If the trees now standing and of bearing age were looked after and protected from insect pests and diseases, this total would be more than doubled."

GRANVILLE LOWTHER

Production of Fruits in Maine

Small Fruits—1909 and 1899

The following table shows data with regard to small fruits on farms.

CROP	Number of farms reporting 1909	Acres		Quantity (quarts) 1909	Value 1909
		1909	1899		
Small Fruits, total	....	1,260	1,585	2,285,415	$233,124
Strawberries	3,464	698	512	1,626,250	168,847
Blackberries and dewberries	1,464	145	123	153,816	15,931
Raspberries and loganberries	1,051	127	131	154,121	20,657
Currants	1,076	80	31	76,031	6,986
Gooseberries	824	59	30	65,867	5,881
Cranberries	536	151	90	100,192	7,957
Other berries	103	(1)	668	109,138	6,865

[1]Acres reported in small fractions.

Strawberries are by far the most important of the small fruits grown in Maine, with raspberries and loganberries ranking next, closely followed by blackberries and dewberries. The total acreage of small fruits in 1909 was 1,260, and in 1899, 1,585, a decrease of 20.5 per cent. The production in 1909 was 2,285,000 quarts, as compared with 1,705,000 quarts in 1899, and the value $233,000, as compared with $158,000.

Orchard Fruits, Grapes and Nuts—1909 and 1899

The next table presents data with regard to orchard fruits, grapes and nuts. The acreage devoted to these products was not ascertained. In comparing one

year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes of tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

The total quantity of orchard fruits produced in 1909 was 3,694,000 bushels, valued at $2,208,000. Apples contributed over 98 per cent of this quantity, pears and plums and prunes most of the remainder. The production of grapes and nuts was relatively unimportant.

The production of all orchard fruits together in 1909 was 156.7 per cent greater in quantity than in 1899, but that of grapes decreased. The value of orchard fruits increased from $834,000 in 1899 to $2,208,000 in 1909, while that of grapes declined from $7,584 in 1899 to $6,954 in 1909. It should be noted in this connection that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits, and the like, and may therefore involve some duplication, while the values shown for 1909 relate only to the products in their original condition.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product		
					1909		1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total	....	3,586,452	....	1,090,768	3,694,251	$2,207,748	1,438,919
Apples	42,976	3,476,616	17,362	1,045,123	3,636,181	2,121,816	1,421,773
Peaches and nectarines	683	5,102	320	3,320	2,014	3,205	1,895
Pears	10,857	46,683	3,170	13,013	38,964	43,524	11,200
Plums and prunes	7,065	43,576	3,614	22,491	14,637	31,954	2,282
Cherries	3,165	14,288	1,271	6,653	2,403	7,164	1,550
Apricots	48	93	25	59	25	38	....
Quinces	48	93	46	109	23	43	(2)
Mulberries	1	1	....	....	4	4	(2)
Unclassified	....	....	....	....	....	....	[3]219
Grapes	2,880	9,731	510	1,944	231,529	6,954	275,800
Nuts, total	....	[4]815	....	[4]142	[4]12,922	[4]414	29,050
Black walnuts	32	231	6	63	1,600	50	(2)
Oilnuts	5	30	2	19	2,975	60	(2)
Chestnuts	24	192	5	18	1,280	100	(2)
Butternuts	38	211	5	29	6,295	152	(2)
Unclassified	....	....	....	....	....	....	[3]29,050

[1]Expressed in bushels for orchard fruits and pounds for grapes and nuts.
[2]Included with "unclassified."
[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."
[4] Includes almonds, pecans, filberts and hickory nuts.

The following table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedule.

PRODUCT	Farms reporting, 1909		Quantity produced		
	Number	Per cent of all farms	Unit	1909	1899
Cider	9,549	15.9	Gals	939,085	376,110
Vinegar	2,884	4.8	Gals	197,996	68,072
Wine and grape juice	54	0.1	Gals	328	628
Dried fruits	267	0.4	Lbs	15,034	26,210

MANURES, GREEN. See *Apple Orchards, Fertilization of.*

MANURES, STABLE. See *Apple Orchard, Fertilization of.*

Marketing Fruits

Next to the growing of fruits the marketing is the most important to the producer. In fact, the manner of marketing and the profits or losses consequent upon it often determine whether any particular person or community of persons can continue in the business of production.

Methods of Marketing

There are several different methods of marketing, among them the following:

1. Barter, a system under which the producer exchanges his products for some other commodity.

2. Huckstering, where the fruit is delivered by the producer direct to the consumer.

3. Selling to buyers who pay cash, expecting to sell again at a profit.

4. Consignment to commission men who handle the fruit on a commission basis and sell at auction to the retail trade, or to other merchants by any one of a number of methods in use.

Selling agencies or associations of sellers have lately endeavored to form connections in all the fruit markets of the world and handle the fruit on a commission basis. The so-called "selling agencies" are large organizations of commission men with wider connections than the commission merchant could have, working as a mere individual or firm.

Stock companies composed of a large number of stockholders who may or may not be growers are frequently formed representing capital necessary to finance the business.

5. Co-operative marketing, where the growers only are members of the organization, and where the form is that of pure co-operation. Stock is sold or a fee charged for membership in the association and each member has one and only one vote, regardless of the amount of fruit shipped through the association.

6. Direct to consumers through "Markets" established generally in the centers of trade to which the fruit is shipped and sold by the producers, the agents of the producers or by the managers of the market.

There are various modifications of the methods and some sellers employ any or all of them as circumstances dictate. A brief description of the various methods will be helpful in correctly understanding the systems named, and in understanding the value to the producer of a careful study of market conditions and the development of a good marketing system.

Barter

Money has come to be the universal medium of exchange, so that the system of barter of goods for goods has almost if not entirely disappeared.

But in the beginning, and still in very primitive societies, the natural division of labor which results from differences in age, sex and natural ability gave rise to commodities which in the absence of money were exchanged for each other directly. Thus old men and boys could make bows and arrows while the strong men could hunt. The results of each kind of labor would be exchanged for each other without the use of any medium.

On this simple basis the value of the articles exchanged was easily measured by balancing in the mind of each party to the trade the strength of his want for his own and the other man's goods.

The Idea of Value

While the elements of the above situation would be comparatively simple, the idea of what determines value is, even in such simple circumstances, not an easy conception to grasp, since many factors enter in to complicate it. Among the factors which go to determine value, we may mention utility, or the usefulness of a given article and labor or the cost of production. The utility of a thing is determined by the number and strength of the wants which it supplies, i. e., by how badly we want or need it.

But utility alone does not determine the market value of a thing or the price it will bring in exchange. As for example, the usefulness of air does not give it a market value, though manifestly we could not live without it. However, if there were only a limited amount of air and some one had it for sale, it would

at once have a market value, and the value or price of any given unit would be determined, first, by how badly folks wanted air, and, second, by how much there was of air to supply the want; i. e., when the amount is unlimited there is no market value, but when the amount is limited there is a market value, provided, of course, that the need of it still exists.

One other factor which affects value but in a more indirect way, is the cost or labor which is necessary to produce a thing. Manifestly, that which is hard to get will be relatively scarce as compared with that which costs little labor. Therefore, the cost of a thing may affect the supply and in this way affect its value. The effect which labor may have is always in proportion to the effect which it may have on the supply. Labor alone cannot determine the value of a thing. For example, it might cost an enormous amount of effort to produce a barrel of air, and yet when produced the merest child can see that it would have no value whatever on the market, simply because the quantity on hand was already so enormous that every one could have all he wanted for the breathing. Or again, I may find a diamond. The labor is nothing. The value is great, simply because the desire on the part of people for diamonds is great, while the supply is limited. Thus it appears that labor affects value only when it has an influence in affecting the supply in such a way as to affect the value. It is true that in the case of the staple commodities for which there is a universal demand the labor cost fixes the point below which price does not ordinarily fall.

Hence, in order to have market value we must always have cost, or whatever goes to determine quantity or supply, balanced by utility, or whatever goes to determine the strength of our wants. The balance of these two factors (utility and labor, or want and cost) is, in the final analysis, the cause of market value. The so-called law of supply and demand is, therefore, the final explanation of economic value and includes all factors which enter into the problem.

The above conclusion is disputed in some quarters but the disagreement arises, like most disputes, out of misunderstanding of the use to which the terms "value," "market," "supply" and "demand" are put.

At the outset it should be understood that the term "value" as here used applies to "exchange" or "market" values only. "Value in exchange" is perhaps a better term to use since it carries the full notion along with it. If no exchange can be made for goods then there is no market, and no price or value can be placed upon them. A "market" is simply the point at which an exchange takes place. Here again we should be careful to avoid misconceptions. We do not mean by the market for peaches, for example, the particular warehouse where we unload our orchard wagon. The market for peaches may be world-wide, in which case the peach market embraces all the varied conditions under which peaches were being sold at a given time; nevertheless, though there may be 1,000 places where peaches are selling, the market is the "*exchange*" and there can never be a peach market where peaches are not selling or where there is no possibility for an exchange to take place, either because there are no peaches there or because no one will or can buy them. Peaches have no value or price where there is no market for peaches.

By "supply" is meant "effective supply." That is, supply which actually offers itself for sale or which it is known will be offered for sale at a given price The mere existence of a supply of peaches at Wenatchee in the orchards does not affect the price of peaches in New York unless the supply gets to New York or is known to be on the way. In other words, unless *in some form* it is offered for sale in New York. There is no market for Wenatchee peaches in Mars. Consequently there is no price set or value fixed upon Wenatchee peaches by the Martians.

In the same sense "demand" is not

merely general desire for a thing. It is "market demand." That is, demand which is willing to purchase or make an exchange for a given article. Demand which never becomes effective in some markets never affects the price or value of a thing. That is to say, if there is no market, if one man having money and another having peaches cannot meet, either personally or through some middleman or agent, so as to make an exchange, there is no market and no price, no value. A desire for peaches in Mars does not affect their price in Wenatchee for the reason that this kind of demand is not effective.

The problem which faces the grower of peaches in Wenatchee who knows of the general desire of men for peaches and who has on hand in his orchard a supply of 10,000 boxes for which there is no market, is not at all a problem of how to account for value in general or of how to account for the fact that he can get nothing for his peaches in Wenatchee. The simple fact is that there is no market, no point at which the general desire of men the world over for peaches and his 10,000 boxes can be brought together so as to effect an exchange. Therefore there is no price, no value.

His problem is rather how to create a value for his peaches by first creating a market. It is a problem in market making, a problem in distribution, and to this problem individuals and associations of distributors must address themselves.

As an example of the operation of this law in the fruit-marketing business we might take the case of apples and bananas. If it costs as much in labor to produce 10 apples as it costs to produce 15 bananas, from that viewpoint 10 apples could be equitably exchanged for 15 bananas; but if the habits of the people were such that consumers preferred bananas to apples, then the case might be reversed and 10 bananas might sell for as much as 15 apples. In this latter case, the profits in bananas would be much greater than the profits in apples, because the cost of producing bananas is one-third less than the cost of producing apples. If the cost of producing bananas and apples were equal and the demand equal, the prices would be equal; but if the cost of production were unequal or the demand unequal, then the price would be unequal.

The fact that cost of production in different localities may vary in comparison with the demand gives rise to the natural tendency for an industry to become localized into those sections where the greatest values can be produced with the least labor. But tariff laws between the nations or other artificial conditions may greatly modify this tendency.

Money and Prices

The money market itself sometimes fluctuates, depending on the supply of money in proportion to the demand. In cases of the financing of great enterprises, a period of great speculation or of disturbances between nations, money may be in great demand, and the prices of other commodities proportionately affected.

Characteristics of Markets

Wynard Hooper, financial editor of the Times, London, writing for the Encyclopedia Britannica, says: "The conditions required in order that the operations of a trading body may display the fully developed market features, whether for commodities or securities, are:

"1. A large number of parties dealing.

"2. A large amount of securities or commodities to be dealt with.

"3. An organization by which all persons interested in the commodity or security can rapidly communicate with one another.

"4. Existence of and frequent publication of statistical and other information as to the present and probable future supply of the commodity or security.

"The changes which take place in prices in any market, whether fully organized or not, depend largely upon changes of opinion between buyers and sellers. The changes of opinion may be caused by erroneous as well as by correct information. They may also be the result of wrong inferences drawn from correct information. In markets for commodities

of the first importance, such as wheat, cotton, corn and iron, the state of opinion may vary much within a few hours. The broad characteristics of markets of this class are similar. There is a tendency in all of them to show phenomena of annual periodicity due partly to the seasons, the activity of certain months being in normal years greater in the case of any given market than that of other months. This tendency is always liable to be interfered with by the special forces at work in particular years, and the great increase in the facilities for communication between dealers by telegraph and of transportation of commodities between widely distant points, which was one of the marked features of the development of the economic organism in all active commercial countries during the last thirty years of the nineteenth century, have still further interfered with it. Nevertheless, a tendency to annual periodicity is still perceptible, especially in markets for produce of the soil the supply of which largely depends on meteorological conditions of the areas where they are grown on a scale to furnish an appreciable proportion of the total produce.

"Periodicity of another kind, known as 'Cyclic,' and due to a different set of causes, is believed to exist by many persons competent to form a judgment."

The law of "cyclic" changes is observed in the United States, with a good deal of regularity, as a period of recession about every ten years and a period of great financial depression about every 20 years. This has been true with slight modification for more than 100 years. Further, there are fluctuations in the markets of annual crops, such as potatoes, more marked than in crops like apples for instance, where it takes several years to grow the trees. Yet in the case of apples, peaches, pears and other tree fruits, much depends on the tendency to freezes, frosts, heavy rains at blooming time and other climatic and meteorological conditions.

Tendency to Equilibrium

"Notwithstanding all the uncertainties named, there is a tendency toward equilibrium," and, as Mr. Hooper further remarks, "Disturbances may take place through a change in: (1) Supply, or an opinion as to the future probable supply; (2) demand, or opinion as to the future probable demand; (3) in both simultaneously, but such a change that demand is increased or decreased more than the supply, or vice versa."

However, every market is at every moment tending to an equilibrium between the quantity of the commodities offered and the quantity desired.

A moderate disturbance caused by any of the changes named, or a combination of them, will produce an immediate effect on the prices of commodities, which again will tend to react on both the supply and the demand by altering the opinions of buyers and sellers. If no further change tending to disturb the markets takes place, the market will gradually settle down to a state of equilibrium.

It is the interest of buyers, as the marketing season approaches, to create the impression that there is an abundant crop and that the supply will be large in proportion to the demand. This is sometimes done in order that the fruit may be purchased at low prices. It is the interest of the growers to create the impression that fruit is scarce in order that they may obtain high prices. There should be some reliable agency for the furnishing of information that is available to all, so that the question would not be one of opinion alone, but of opinion based on the facts. The government monthly reports are available to all in the "Crop Reporter," but the method of gathering the information, compiling, and getting it out to the farmers by mail only once each month, often brings the information too late for intelligent action. There should be some means of reporting similar to that of wheat, corn and other standard products

Future Delivery

A certain proportion of purchases are paid for at the time of purchase, but an increasing number of commodities are purchased for future delivery. This is on account of the tendency to large or-

ganizations of buyers, who desire to supply all their customers at all seasons of the year with whatever the market demands. With the buyers' organization, future delivery is a kind of insurance that the products can be supplied at a given price. With the seller or seller's organization, it is a promise to supply it at a given price. The seller believes he can furnish the fruits at that price at a profit. The buyer knows, if the goods are delivered according to contract, that he can supply the market at a profit. This would seem to be better for both the seller and the buyer, but it has been subject to many abuses.

Market Corners

"Corners" often result from the contract for "future delivery." They may result from a mistaken judgment of a number of persons as to the supply of products. As a result, persons who have made contracts for future delivery at certain dates, are unable to fulfill them. The fact that the market is oversold soon becomes known and the persons holding products who could supply the demand raise the price against those who are buying to fulfill their contracts. If a dealer has undertaken to deliver 100 cars of fruit at a certain price and it becomes known that fruit is much more difficult to obtain than he calculated it would be, and those who have the fruit for sale know that he is compelled to deliver, they might compel him to pay two prices in order to fill his contract. He has contracted to deliver believing that he could do so at a profit, but in the case described he does so at a loss. There are a few growers who will contract ahead to deliver fruit at a fair profit. Others will contract to deliver a certain proportion of the crop at a fair profit and hold the remainder of the crop for speculation, taking their chances that it will be higher than the average.

The Standard Dictionary defines "a corner" as follows:

"A corner is the result of the purchase, or contract for the purchase, of a commodity by a person or combination of persons so as to command the market and be able to fix the price of the commodity."

Selling to Buyers Who Pay Cash

Selling to buyers who pay cash for the products is an old method and has a number of advantages. The producer receives his money early and so is enabled to meet his obligations without borrowing heavily. Some claim that in the long run the grower who sells for cash at the prevailing market price at harvest time will, all things considered, come out ahead of those who wait for an expected rise later. In a fruit-growing district where a large volume of fruit must be marketed, this method can only succeed in the case of a few. To attempt to force the whole output of a district upon the market at once would be out of the question both on account of the enormous capital required and because of the disastrous effect on prices.

Another advantage to the grower is that it closes the transaction without further risk to him, compelling the buyer to assume the risk of unloading with profit on future markets. It is vastly superior to the consignment method, a discussion of which follows.

The Consignment Method

Under this system fruits are consigned to commission merchants who sell the fruits on a percentage basis, at auction, to the retail trade, or to other commission merchants as seems to them best. This system is subject to many abuses and temptations. I would as willingly send my pocket-book to a man in Chicago or New York whom I did not know, or if I did know would not trust, as to send him my fruit.

When he has possession of the fruit, if he is dishonest, he might say that "It arrived in bad condition," sell it for a good price, send the consignor the price of damaged fruit and keep the balance. He might be a partner of a firm of retail merchants and keep the fruit, reporting it to be in bad condition and return to the grower or shipper whatever he pleased. He might do any one of a number of things which would be to his own advantage and the disadvantage of the

grower, or he might be honest. There are honest men in the business, but they have to compete with men who are dishonest.

The consignment method has the disadvantage of the grower furnishing all the fruit, running all the risks of transportation, markets, the honesty or dishonesty of the person to whom it was consigned, while the consignee runs no risks, has no capital invested, and is often financially irresponsible. There is a movement now on foot which may result in requiring the consignee to send to the consignor a certificate from the buyer stating to whom the fruit was sold, the price paid, the date of sale and other important items. "Consigned goods are supposed to be the property of him by whom they are consigned, to be disposed of by him to whom they are consigned."

The system might also be improved by requiring that persons acting as consignees for the public should give bond for the honest and faithful performance of the duties of their position. With honest and far-seeing men engaged in this business, there is a business pride in pleasing their customers, establishing confidence and continuing in the business, but the system furnishes unusual inducements to irresponsible persons.

The legislature of the state of Washington, in 1912-13, passed laws designed to protect the grower and consignor of products, and to prevent fraud on the part of commission merchants to whom products are consigned.

The essential weakness of this method of selling anything lies in its violation of the axiom of trade "never part with your property without a consideration." By this method the producer virtually gives away his product, almost his only reliance being placed in the honesty of those who handle it for him. It is argued that the necessity on the part of the commisson man to return a fair price to his client in order to retain his business, and the "honor of the house," are sufficient safeguards to the grower.

While indeed there is much to be said on this side of the question, it has been the sad experience of growers that the "honor of the house" is a vain dependence and that the only real safeguard is a community of interest. This common interest is not present. The commission man is interested primarily in his commission, not in the profits of the producer.

The opportunities for taking advantage of the trustful grower are numerous and have in the past proven too great temptations for the commission men. The ordinary grower has no means of tracing his product and it is easy to return a false report of "arrived in bad condition" or other subterfuge to cover up a deal in which the commission man has reaped a big profit.

The current expression "As well trust your pocket-book to a man you do not know as consign your fruit to be marketed away from home" gets at the essential weakness of the system. The injury to the business has reached almost the stage of demoralization at times. Yet it must be said that the steps by which the consignment business grew up are perfectly natural ones.

Selling Agencies

Lately there have grown up organizations known as "Selling Agencies." These agencies, in so far as we can discern their purposes and methods, are not much different from "Commission Merchants," inasmuch as they sell on commission. The differences seem to be largely in the fact that they are organized in a large way, as fruit distributors or sales agents, are therefore more responsible and are less subject to temptations to dishonest dealing. They cover a large territory, and have good facilities for successful distribution.

They generally publish that they "Have no capital stock and are prohibited from engaging in the business for profit." They have a "Central Organization," and subsidiary "District Organizations."

The management of the "Central Organization" is under the control of a board of trustees, consisting of one representative from each district organization.

"The board of trustees elect all the of-

ficers of the exchange." "The right of recall is reserved by each district." "All officers holding positions of trust are bonded." "An annual open meeting is held by the trustees, at which all interested growers are privileged to be present and receive a general report of the business."

Provisions are sometimes made "Whereby upon questions of sufficient importance the voting strength of the trustees is proportionate to the relative shipping tonnage of their respective districts."

The principal functions of such an exchange are "The distribution and marketing of fruits, and the gathering and dissemination of market information."

The City Market

The Market is a place where traders or producers are awaiting buyers, in shops, stalls, booths, open spaces, or other convenient places for the accommodation of the general public. The idea is to bring the producer and the consumer as nearly together as possible.

Originally, the producer brought his goods, rented space, or a stall, and sold to the pruchaser direct. The purchaser, in turn, bought at the market-place and carried the goods purchased to his home. In ancient times slaves did most of the buying in the market-place. In later times the system of the delivery of goods has caused the managers of markets to provide for the delivery of the articles purchased to the homes of the purchasers; but in turn, the use of the automobile has made it possible for persons on pleasure trips to stop at the market on the way home and purchase such things as they choose, delivering them without the added expense of the market delivery.

The manager of the market now often acts as selling agent, receiving the products on consignment, selling them at the prevailing market price, and returning to the producer the amount received, less a commission and the cost of delivery to the purchasers.

In most of the large cities of the United States and in Europe there are one or more market places. In some of the cities of Europe a huge collection of shops with various co-operative stores may be seen as an evolution of the old market system. The market has generally been considered the trading place of the poor and middle classes where they could purchase at less price than in the ordinary mercantile establishments, and where they could eliminate the cost of delivery by delivering the goods themselves. At the same time, the producer is supposed to get more for his goods in this way than by the ordinary methods of sale.

Stock Companies

Local organizations are often formed in which the organization is financed by the sale of stock. Sometimes this stock is owned wholly by the fruit growers, sometimes partly by the growers, and at other times mostly by bankers, merchants and others who believe the stock a good investment, or who desire to help the industry as an asset to the town. Some of these organizations have been very successful from the stockholders' viewpoint, in that good dividends have been returned to the holder of stock. Some of them have also been of benefit to the grower as well as the stockholder.

In this kind of organization there seems to be, inevitably, a conflict of interest between the stockholder and the grower. The grower naturally desires to make as much out of his fruit as possible. But if he makes large profits it often happens that the stockholder makes small profits. It mostly depends upon the management and purposes of the organization. If the dominant purpose is to make money for the growers, then it cannot at the same time conserve the interests of the stockholders. If the dominant purpose is to make money for the stockholders, then it must in the nature of things buy the fruit for a small price and sell at a higher price, and this would not sufficiently conserve the interest of the growers. In other words, the growers and the stockholders are on opposite sides of the market problem.

This is true if the stockholder and the grower are one and the same; for then

the stockholder-grower is in competition with himself. However, many of these stock companies have been substantially mutualized by allowing the stock to represent buildings, storage plants, warehouses, etc., and the selling agency a mutual association in the interests of growers.

State Marketing Agency

As usual, California takes the initiative. California has passed through years of struggle not common to the Eastern states, and from experiences growing out of her necessities, has evolved some lessons of value to all the world, but more especially to all the Pacific coast states. In the November (1913) election, she voted on the question of a "State Produce Exchange Market, for all California Farm Products."

Thirty thousand signatures were necessary in order to get the question on the ballot. The signatures were obtained.

The proposed law called for the appointment by the governor of a commission of five, each to receive a salary of $6,000 per year and devote his entire time to state work. One of the five was to go out of office the first of 1915, two the first of 1917, and two the first of 1919. The act was to give the commission an attorney at $4,000 per year, and a secretary at $3,500 per year and such other employees as were necessary to carry on the work.

The bill called for an appropriation of $200,000 to place the exchange on its feet. It called for at least two offices, one in Los Angeles and one in San Francisco. It provided that the commission may sell all agricultural, horticultural, dairy and farm products on consignment, within or without the state; that agencies and packing houses may be established all over the state; that a standard system of packing be established and enforced; that a bureau of information be established; that supply and demand problems and other questions of interest to the producers be investigated and bulletins issued to them. It is to be supported by fees collected from consignors, and is to make settlement with the growers once each month. This bill failed to pass but has many earnest supporters and will probably be presented again.

Marketing and Parcel Post

A new feature of marketing conditions has arisen on account of the enactment of the parcel post law, which places the government as a carrier of parcels in competition with the express companies. In some instances, parcels have been carried by the government from the place of manufacture or production to the consumer, thus eliminating the agent, merchant, commission man or whoever formerly acted as distributor to the consumer. In other cases, the express companies have reduced their rates in order to meet the competition caused by the parcel post acting as distributor.

In New York city, for instance, the express companies have organized a class of consumers to whom they agree to distribute farm products at much lower prices than they would have to pay under the ordinary methods of distribution. At the same time, in carrying out that plan, they can give to the farmers for their products more than they had formerly received. One of the express companies cited this instance, that the farmers in the outlying districts were receiving 50 cents per bushel for their apples. The consumers were paying 15 cents a quart, which is equal to $4.80 per bushel. This left for carriers and distributors $4.30 per bushel. It made the price of apples so low that farmers could not afford to produce them, and the price to consumers so high that few could afford to buy them. The express companies figure that they can pay to the farmer 75 cents per bushel, which, as the lower grades of apples are produced in some of the sections of the East without much expense, will leave to the producer a fair profit; then they can be distributed by the companies to the consumers at less than half the usual cost, greatly reducing the cost of living and increasing the profit to the producer. The difficulty in such a method is largely with the farmers, for the express companies complain that they are not sufficiently organized so

that they can be depended upon to furnish the products regularly and in such quantities as will supply the demand.

CO-OPERATIVE MARKETING

It is hardly possible to understand co-operative marketing, without a brief history of co-operation. In all ages of human history persons have combined their interests in some degree for mutual protection against adverse conditions. It was not until the beginning of the 19th century, however, that modern co-operative movements took shape.

The chief of these societies were those organized under the teachings of F. M. C. Fourier, a Frenchman, and Robert Owen, an Englishman. Fourier's economic theories were that up to a certain degree "Each should work for all and all for each." In the production of wealth, society should be divided into "phalanxes, series, and groups." Each group was to have charge of one kind of work, and each series one special branch of that work.

In the distribution of products a certain minimum was to be assigned to every member of the society, whether capable of work or not, the remainder to be shared in proportion to the labor performed, the quality of the labor, and the capital invested.

Robert Owen was the owner of large cotton spinning mills at Lanark, England. His theory was that "All men are equal." He obtained the assistance of certain benevolently inclined capitalists with whom it was arranged that after the capital invested should have received five per cent per annum all the profits should be laid aside for the educational, religious and moral improvement of the workers.

Owen made the town of Lanark a model to be visited and studied by philanthropists of all civilized lands. Of it he wrote, "For 29 years we did without magistrates or lawyers, without a single legal punishment, without paupers, without intemperance or religious animosities. We reduced the hours of labor, well educated all the children, greatly improved the condition of adults, paid interest on capital, and cleared 300,000 pounds ($1,500,000)."

Out of the impetus given by the teachings of Fourier and Owen have grown the "Rochdale Societies," "Union Shops," and other organizations for the benefit of wage workers, farmers and others.

Causes That Led to the Movement

Aneurin Williams, M. P., author of "Twenty-Eight Years of Co-partnership, Etc.," writes as follows in the Encyclopedia Britannica:

"The end of the 18th century and the beginning of the 19th were culminating days of industrial revolution; when the older organizations of society had given way to the factory system, and the population of the factory districts was suffering a martyrdom, with ruin of body and degradation of character from unbridled competition, long hours, women's and children's labor, pauper apprenticeship, great fluctuations of trade and employment, dearness and adulteration of provisions, the truck system and insanitary homes."

The English missionaries sent to India about that period, when the power loom was installed to take the place of hand weavers, reported: "The bones of hand weavers are scattered all along the highways, for they have starved and their friends are too poor to bury them."

Rochdale Pioneers

About 1844, 28 poor men at Rochdale, Lancashire, England, got together a capital of 28 pounds, and opened a little shop, which has in all essential particulars been the model of most of the modern co-operative societies. They succeeded in improving the position of workingmen by enabling them to buy pure provisions at less cost, unadulterated; to save money, to pass from retail to wholesale trade, from distribution to manufacturing, ship owning and banking, and to live with an object and ideal.

The principal difference between the Rochdale plan and the Robert Owen plan was in the method of dealing with the profits. The Owen plan provided that after five per cent on the investment was paid, the profits should be kept for the

improvement of society or divided equitably among the investors. The Rochdale system provided that after five per cent on the invested capital was paid, all profits should be allotted to the purchasing members, in proportion to their purchases until their purchases amounted to five pounds. Thus each member found it to his interest to purchase at his own store and introduce new purchasers, because the profits on purchases by those not members went to the holders of stock or of membership certificates.

The modern co-operative societies also do a banking business and lend money to their members to buy cottages. It is because small amounts are contributed and owned by so many persons that in the aggregate the wealth is great. The management is democratic, each member having one vote, and not, as in most stock corporations, a voting power in proportion to the stock owned.

Financing a Co-operative Movement

It has been considered that the fruit business is not as safe an industry on which to advance money as the growing of such products as wheat, corn, oats, cotton, hay and other staple commodities, for which there is a constant demand in something like fixed quantities. While it is true that the staple crops fluctuate more or less, yet if wheat for instance, is high priced on account of a shortage in the supply or for any other reason, the tendency would be to substitute some other food such as corn, potatoes, rye, etc., to supply the deficit in wheat, and the tendency would be toward an equilibrium. With fruit, it is argued that there is less demand, that it is not a staple like wheat, but is more of a luxury, and that therefore the fluctuations are greater. Further, the danger from frosts and other climatic conditions is greater to fruit than to other crops. Therefore bankers hesitate to lend money on fruit.

Bankers are not to blame for this because they are handling trust funds and are hedged about with laws which if violated would in case of panic imperil them. In case, however, the fruit grower can not get such accommodations as he desires, it is possible for him to finance himself.

How to Finance Himself

Suppose the farmer considers that he is taking the risk because he owns the fruit. He joins a strong co-operative association and signs a contract to deliver his fruit to the association. Suppose then that in the local community there are 300 members of the association and that they agree to start a small bank of their own. This can be done in a small way without much added expense of office rent, clerk hire, or furniture. Suppose the average deposit of the 300 members is $300 each. This would make an aggregate amount of $90,000, on deposit. The presumption is, that 25 per cent of this amount must be kept on hand for the use of depositors, but that 75 per cent may be used as working capital. This would leave $65,500 for working capital to be used by members of the association.

The risk is not increased materially by the farmers making their own deposits in their own banks. They assume no risks they would not assume in the ordinary way of banking.

This plan is not new but has been tried in many farming communities in the United States and in Europe and found to be practicable.

GRANVILLE LOWTHER

The Fundamentals of Co-operation

H. C. ATWELL

Forest Grove, Oregon

All co-operative undertakings involve the same basic principles.

Organized co-operation may be limited to a single community, or it may embrace several communities as units of a wider co-operative system.

I. Confidence

There is one fundamental, however, which is vital to success of any co-operative undertaking whether local or general. No matter how narrow or how wide the scope of your co-operative system, it will fail if its members have not confidence in one another. Lack of confidence has been

the principal deterrent to co-operation among farmers Stockholders in any other line of production elect their directors from among their own members, and then go their way serenely confident that their chosen representatives will conduct their affairs with honesty of purpose, and to the best of their ability. Why should not farmers take the same sensible course?

Slow growth of the co-operative idea among farmers is largely due to their isolated condition. Large farms and bad roads make neighbors few, and interchange of ideas among them difficult These unfavorable conditions have always been a feature of rural life The resulting mental attitude has become an inherited trait

Confidence is the chief corner stone of co-operation Without it the edifice can not stand. Confidence is, however, the outgrowth of acquaintance. Acquaintance depends on opportunity for frequent intercourse. If this opportunity be not afforded, distrust instead of confidence marks the dealings of man with man. Distrust is fatal to successful co-operative effort. The smaller the area whose growers attempt to co-operate, the easier it is to promote that confidence which acquaintance begets.

II. A Modest Beginning

The local association should not undertake to do too much at the outset Construct your buildings and provide your machinery with a view to future extension, rather than with the idea of affording present facilities for future needs. If you contemplate a cannery equip yourselves to handle at first only those fruits and grades for which there is most urgent need of outlet. When you have proven yourselves, you can more safely expand If successful with your initial venture, you will have won self-reliance and credit These mean capital.

III. A Strictly Co-operative Basis

Many types of local growers' organizations exist Some are very democratic, every member having an equal voice. Others allow participation on basis of acreage or of fruit output Others are pure stock companies, with or without limitations upon number of shares any member may hold. Some are organized for profit of stockholders. This will most likely be true when a considerable portion of stock is held by those who are not fruit growers. Other associations are composed entirely of growers, to whom is prorated back whatever profit is earned by the organization. If I were asked which is the *ideal form of local organization*, I should answer, speaking of course from the growers' standpoint—"an association strictly co-operative and non-profit sharing, each member contributing capital and having a vote in proportion to his acreage of bearing trees."

Only such associations as transact business of their members at cost can expect long to retain the confidence and support of their members. Payment of large dividends to non-fruit growing members, or to those whose stock holdings exceed the proportion of their bearing acreage, is demoralizing. Such dividends are earned at the expense of the grower. Such arrangement defeats the primary object of the association, which is to reduce expenses of the grower to the minimum.

It is, moreover, unnecessary to organize on a dividend basis. You don't need to ask your banker, merchant and money lender to become stockholders. Your land and trees are sufficient basis for all the capital you will require. Finance your own undertakings. Let each member advance, borrowing for the purpose if he must, such proportion of the needed capital as his bearing acreage is of the total bearing acreage. The association is then equipped and out of debt. It can borrow, at low rates, any sum it may require for crop movement.

Not only is the strictly co-operative association the ideal one, but it is desirable that all local associations embraced in one central organization (of which I shall speak later) be organized along identical lines This uniformity is found in the different locals of the Yakima Valley Fruit Growers' Association, in the state of Washington Their's is an exceedingly well thought out plan, compre-

hensive in detail and efficient in execution.

IV. Provision for Off Grades and By-Products

Most local associations would and should ship their best fruit in its fresh condition. There are often times, however, when highest-grade fruit and most efficient distributive machinery can not overcome a dull market. Fruit growers will also always have more or less off-grade fruit. Happy is that local association which is equipped to can, and evaporate, and make into jellies, juices, cider and vinegar, the fruit for which it can not otherwise find a profitable market. Some of these by-products will make a nice profit. Any of them will assist materially in paying expenses of the association. These instrumentalities should not, as a rule, be considered the main proposition They should be regarded in the light of insurance; insurance that you won't have to throw away or give away your product if fresh fruit prices are not satisfactory; insurance that there will be no waste of culls; insurance that the local buyer will offer you a fair price, because he knows that you have other means for disposing of your fruit. If most of your apples command a fancy price, you can afford to let your apple-canning machinery lie idle. If all your prunes are wanted fresh, you can bank the fires in your evaporator.

V. Control of Distribution by Contract Holders

Safeguards should be adopted, and made of uniform application, whereby control of output and of marketing facilities shall remain in the hands of those who produce the fruit marketed. Those local stockholders who ship no fruit should not be allowed to dictate through what channels the growers' product shall be marketed, after it passes from the hands of the local association. Such stockholder is, of course, entitled to a reasonable return upon his stock, and to a voice in local management and charges. Beyond that he has no right. To give him a share in control of ultimate distribution, at once takes the local association out of the list of growers' organizations It makes it possible for private interests to secure local control and thereby to direct distribution into channels antagonistic to the grower.

To prevent this undesirable result, every local association should embody in its fundamental law the provision that "in all matters pertaining to marketing and affiliation, voting shall be restricted to members holding marketing contracts." Adoption of this provision should be insisted on, before the local association is permitted to participate in any co-operative central selling agency.

VI. Freedom of Officers From Connection With Competitors

Chiefly aimed at the same object is my next fundamental, that provision should be made that no officer or trustee should be permitted to hold any office or position in the employ of, or to be connected with, or to own any stock in, any competing organization or firm. Without this wise and just provision, the association might be put to great embarrassment, and its plans perhaps nullified. Exception, of course, should be made where a man holds stock in another growers' co-operative association.

VII. A Self-Continuing Contract

Another fundamental of co-operation is that every fruit-growing member of a local association should be required upon becoming a member to sign a self-continuing contract. By this I mean a contract whereby the grower agrees to turn over to the local association all his fruit, growing and to be grown, during every year continuously. The contract should not be for the current year or for a limited number of years. Opportunity should, however, be given the grower to cancel the contract in any year. Otherwise the local association would be given an unreasonable power, and it would be difficult to get any fruit signed up. The pivilege of withdrawing should, however, be confined to a short period, and to such season of the year as will enable the local directorate to know in advance what they can depend on for the ensuing year. The point is covered by the

following clause in the growers' contract provided for in the plan of the Yakima Valley Fruit Growers' Association:

"Provided that the grower may cancel this contract on March first of any year, by giving notice in writing at least 20 days prior to said date."

This provision releases a grower from necessity of turning in his fruit the next year, if he is dissatisfied with results of the previous year. The management, on the other hand, know 20 days prior to March first just how many acres they will control for the ensuing year, and can plan accordingly. This arrangement adds to the efficiency and economy of the local management. Without this provision the directors would not know, until time for shipment, and in many cases not till after shipping season had opened, whose fruit they would have to handle. Such a state of uncertainty is not only embarrassing to the management, but it renders it impossible for them adequately to perform the most important function of their office. Every manager of an association not having the continuing contract will tell you that the average grower will defer signing up his crop as long as he can. California Fruit Growers' Exchange, after much bitter experience along this line, adopted the continuing contract.

VIII. Penalty for Outside Selling

It is a lamentable fact that there is a considerable element among fruit growers, as among other classes, who will not, without compulsion, perform a contract, when it is temporarily for their interest to break it. Such men are not without encouragement from outside influences, whenever an opportunity is seen to embarrass co-operation.

To guard against occurrences of this kind, the contract made by the local association with its growers should contain a clause imposing a penalty for selling fruit outside the association. Without such provision, the association would have no solid foundation. It would be in continual uncertainty as to how much fruit it could control. It would be in almost as weak a condition as without the continuing contract. This penalty should be sufficiently large to act as a deterrent to outside selling. In California the sum specified varies from 25 to 50 cents a package. Following may serve as a guide in formulating a provision to cover this point:

"In consideration of the benefits conferred on me by acceptance of this contract for packing and marketing my fruit in the Fairview Fruit Growers' Association, I agree that, if at any time during the life of this contract I shall fail to deliver to said association all my fruit, as hereinbefore agreed upon; or if I shall dispose of all or any of it elsewhere, otherwise than as herein agreed upon, I shall forfeit and pay to said association, as liquidated damages, an amount equal to 50 cents for every box or package of fruit shipped or sold otherwise than as stipulated in the contract; it being specially agreed that it is impracticable and extremely difficult to fix the actual damages which would be thereby suffered by said association."

It will be noted that I have included in the foregoing form allusion to a consideration, and have designated the penalty as liquidated damages, both features worth consideration. Too much care can not be bestowed on the growers' contract. It constitutes the basis of marketing operations.

IX. Maintenance of High Standards

In this connection I would say that a good reputation is as essential to success of an association as of an individual shipper. Constant vigilance must be maintained by the management, lest some growers assume that the good work of others will offset their own carelessness.

X. Pooling

Pooling is a necessity incident to co-operative marketing. It will, however, have a tendency to lower the average grade, unless watchfulness is exercised by those in authority. As far as practicable the fruit only of those growers who have similar conditions should be pooled. Pooling is a purely local issue. It should be confined to fruit raised within a limited area. It is not practicable to extend its

scope much beyond the limits of an individual association.

XI. Co-operation in Buying

The local association should aim not only to sell its members' fruit but to purchase their orchard supplies. Great savings can be thus effected in the purchase of many items. The association can also manufacture some lines of spray material, largely reducing the cost thereof to members. The Eugene, Oregon, association makes a superior lime-sulphur, at exactly one-half the cost of the boughten article. If the various locals are combined in a central agency the latter may purchase for all, in which case a larger percentage may be saved, on account of the larger quantities handled. California Fruit Growers' Exchange, through a subsidiary company, thus annually saves to its growers several hundred thousand dollars.

Benefits accruing to the grower from exercise by the local association of its purchasing function will often keep him in the co-operative ranks, when he would otherwise be inclined to cancel his membership.

XII. Service Only for Members

If one is not willing to assume the burdens of membership in a local association, he should not expect to share in its benefits, either in the sale of his fruits or the purchase of supplies. To allow him to do so on an equality with members is an injustice to them. To serve an outsider for profit opens the way to discord, and introduces the element of speculation, from which a co-operative organization should stand entirely aloof.

XIII. Choice of Manager Not a Subject for Economizing

A co-operative organization should economize in all matters except the hiring of a manager. In that office, the man is the first consideration, his compensation a secondary matter. Success or failure depends on the manager. The directors can advise. They can not execute. The executive head should be patient, tactful, competent, aggressive. He should receive a salary commensurate with his ability.

XIV. A Central Selling Agency

Thus far we have discussed fundamentals of co-operation as applied to individual associations acting independently. We have treated them as unrelated entities. We have strengthened the weak parts. We have constructed a perfect local machine; a machine that, a few years ago, would adequately have performed the functions of distribution. It may yet suffice for the handling of many products. However, as regards commodities produced in large quantities, and over wide areas, the problem of distribution is too big for the local association.

The great problem confronting all producers of material commodities is efficient distribution. That distribution is most efficient which brings producer and consumer into closest relation, which most thoroughly and evenly covers the consumptive field. Evenness of distribution avoids gluts and fills the empty market. Economy of distribution eliminates superfluous media of exchange, and avoids duplication of effort. It thereby cheapens price to consumer and enlarges consumptive demand—conditions which make for cheap, rapid and widespread distribution, by insuring economy and even rewards of production, without increasing burdens of the consumer. The American people are awakening to this fact, and also to the fact that, without combination of distributive agencies, evenness of supply and stability and reasonableness of price are impossible. Promoters of manufacturing and other corporate enterprises have recognized the same fact. They have been compelled to unite with others similarly situated, to eliminate wasteful methods of distribution. Their activities have been directed toward evenness of supply; not oversupply in one market and under supply in another.

"Big Business" has come to stay, because it answers an economic want. It is based on co-operation. Co-operation and combination are supplanting competition and waste. The biggest of big businesses, however, has made but slight progress toward establishing itself on the basis of co-operative centralized distribution. Ag-

riculture, representing over 50 per cent of the population of Canada and the United States, is the one department of production most in need of, and most conspicuously lacking, efficient organization along this line.

Fruit growers have made great progress in local organization, but as before stated, the local association is impotent before the problem of wide-spread distribution. It matters not how well the local is organized and managed, how efficiently it is equipped, or how thoroughly co-operative is its construction, efficiency of distribution can not be attained through independent action of a score or more of local associations, each striving to overload the same markets, each duplicating the other's expense account. Only by centralizing their distributive energies can they secure that evenness and economy of distribution necessary to secure best results. They must unite in one central selling agency. This is my fourteenth fundamental.

In advertising, also, the locals may profitably co-operate. In 1911 California Fruit Growers' Exchange, a central selling agency, spent $50,000 in advertising California "Sun-Kist" oranges. Results were so satisfactory that they will this year devote $100,000 to the same object. Could any merely local organization afford such expenditure? If it would combine with the other local associations, its individual share of such expense might not be oppressive.

In 1911 the same California organization, through the subsidiary company I have alluded to, was able, by levying 5 cents a box on fruit sold by it, to establish box factories, at a cost of some $200,000, and thereby save 6 cents on the cost of every box to be used by its members during a term of several years.

These are two concrete examples of what confidence and common sense may accomplish, when applied to co-operative endeavor through a central agency. These facts came to my knowledge during a recent trip to California, and may be news to some of you. I might cite other activities of the same organization, all on the same scale, and all impossible of performance, except through a strong central agency.

Fundamentals Relating Specially to a Central Agency

Assuming that a central selling agency is necessary, if fruit growers are to reap full benefit from efficient local organization, I wish to mention some vital principles specially relating to the central agency. All the fundamentals I have discussed apply, for most part, to both local and central organizations. There are, however, three which apply only to a central agency.

XV. No Capital Stock

The central exchange should have no capital stock. By this I mean only a nominal capital. California Fruit Growers' Exchange has, in the last six years, sold nearly $70,000,000 worth of citrus fruits, kept constantly employed some 100 high-salaried sales agents, and handled several million dollars worth of fertilizers, boxes and other orchard supplies. Its capital, all that time has been not to exceed $16,000. The local, not the central, organization is where capital is needed. Packing houses and storage houses should be financed locally. Growers have the land and the credit to build them. Fruit passing through the hands of the central exchange can be easily made to provide funds for any extraordinary need of the central. Accumulation of large capital at headquarters would arouse distrust on part of growers. It would embarrass the central agency in many ways. The latter should not be burdened with large financial responsibilities. It should be free to devote its entire energy to distributing, advertising and gathering market information. California Fruit Growers' Exchange does not handle a cent of the proceeds of fruit sold by it. The proceeds go direct from its sales agents to the district associations into which the various locals are grouped. Expenses of the central are covered by requisition made by it to the district associations.

XVI. District Organization

It will be found expedient to follow the California plan, in matter of district organization. There various locals are grouped together, within convenient geographical lines. Each group constitutes a district, with an organization composed of representatives from each local within the district.

The principal functions of the district organization should be control of all matters within its boundaries, relating to inspection, picking, grading and packing fruit; co-operative purchase of supplies; choice of directors for the central exchange, and adjustment of any disputes arising between central exchanges and local associations.

XVII. A Council of Representatives

Provision should be made whereby, upon questions of sufficient importance, voting strength of the directors of the central exchange could be proportionate to the relative shipping tonnage of their respective districts. This could be accomplished by providing an auxiliary board, said board to be composed of one representative chosen by each district organization, and to be known as the Council of Representatives. This council would be called together only when the board of directors of the central exchange should, upon request of two of its members, demand the submission to said council of any specific question before the board. When called together, the voting strength of each member of said council would be a number of votes equal to the number of carloads of fruit shipped by all growers then affiliating under the district organization represented by him during the last preceding season. Any decision of said council would be final and binding on the directorate of the central exchange.

This plan is a feature of the California system. It is interesting to note, however, that, while it affords necessary security to larger districts, if conditions should require it, this council has not been called into service during the last six years.

Need for Improving System of Distribution

I have thus outlined principles, the application of which I regard as fundamental to successful co-operation. I acknowledge my indebtedness for valuable suggestions to the able and comprehensive article on "Co-operation in Handling and Marketing Fruit," written by Mr. G. Harold Powell, and appearing in this section. Several of them are advocated in the report of the Committee of Eleven, an organization working in Washington and Oregon for the establishment of a central selling agency, and of which I am a member. That there is need of improvement in our system of distribution can hardly be denied. In face of the fact that increasing production demands increased consumption, high cost of living is curtailing consumption. To meet necessities of consumers, prices must be reduced. Shall this be accomplished by reducing the farmer's returns? Already he is receiving a reduced proportion of the retail price, although his expenditures for living and labor have increased. Evidently consumers' cost can be lowered only by reducing the aggregate of tolls for carriage, insurance, brokerage, commission and retailing.

As aptly put in an editorial of the Oregonian, "Middlemen bear the price paid to producer and bull the price paid by consumer."

I do not preach a crusade against middlemen. We should not expect or wish entirely to eliminate them. They are average citizens, and are making the most of their opportunities, as the rest of us are trying to do. We are, nevertheless, justifiable in seeking to dispense with their services, whenever possible, and to hold their charges to a reasonable basis, always. Our products pass through too many hands before they reach the consumer. This again means waste—a waste that works against two classes, the producer and the consumer. As the Oregonian well puts it, "only the middleman profits by the confusion." There is little doubt that a central selling

agency can establish more direct relations with consumers, and maintain those relations more steadily, than can an individual or a local association.

Co-operation With Consumers

The many consumers' leagues, springing up in the more densely populated districts, afford our opportunity. Why should not the producer and consumer cooperate? They can, if they will both organize. Central selling agencies and central purchasing agencies will be familiar features of the near future. The mayor of Indianapolis, with his 900 consumers, has pointed the way. Of course, this idea will be declared absurd on "commercial row." The railroads said government regulation was impracticable and unjust. Now they want more of it The trusts declared the Sherman Anti-Trust Law a dead letter. Now they are making haste to adjust themselves to its requirements. The hack driver decried the electric line from the steam railroad station. Now he collects fares on the same electric line, and doesn't get his coat spattered with mud. Changes of business methods gradually work out their own adjustments, without serious injury to any class.

Other Examples of Widespread Co-operation

California Fruit Growers' Exchange is not the only successful example of cooperative distribution on a large scale. In Holland thousands of egg producers market through central organizations. Grain farmers of the Central West have their central shipping association. Numerous examples might be cited. Nearer home, though not embracing so many different communities, is the Puyallup and Sumner Fruit Growers' Association, in the state of Washington. That organization, under the conspicuously able management of Senator W. H. Paulhamus, has long been an object lesson in successful co-operation. Long after Senator Paulhamus' fame as a statesman shall have faded from the public memory, he will still be quoted as the man who made the Puyallup valley worth $1,000 an acre, through his efficient exploitation and marketing of the lowly evergreen blackberry

Growth of Movement for Wider Co-operation

In California the deciduous fruit interests are seeking to organize on lines of California Fruit Growers' Exchange. It is no infant's task to merge all their divergent interests. Happily, the burden has fallen on J. W Jeffrey, manager of the Deciduous Fruit League of Sacramento, and late Commissioner of Horticulture of that state. His 30 years' efficient and valiant service for co-operation is a guaranty that the cause will not lag under his guidance.

Central Selling Agency for Northwest Apples

In Washington and Oregon the apple growers are feeling their way toward one another. Three years ago, when I began to agitate a growers' central selling agency for Northwest apples, I was voted a dreamer. It was argued that if a central selling agency could even be started it would quickly collapse before the problem how to handle all the apples of the Northwest in one pool, in view of the mutual jealousies of various localities. Of course, no idea of attempting such a thing was contemplated by us. Other equally unreal men of straw were set up by those whose zeal to discover obstacles in the pathway of co-operation overshadowed their fund of information.

In my judgment, organization of our agricultural class, for a more comprehensive system of co-operative distribution, is one of the most important works to which our public-spirited citizens can address their efforts. There is great interest, nowadays, in the problem how to better social conditions of the farm, how to get people back to the land. The banker, the agricultural college and the commercial club have joined to find a solution. They hope to solve the problem by popularizing agricultural education, and teaching the farmer how he may extract more from the soil. Leaders of the propaganda overlook the fact that the most potent organization to effect better methods of farming better methods of

handling farm products, greater agricultural prosperity, better rural citizenship and social life, is a successful association of farmers themselves, formed to secure better distribution of their products.

In a community having such an association in successful operation, it is unnecessary to raise the cry "back to the land." Every one who can afford it gets back, without waiting to have a pry applied to him. If some of our well-meaning friends would devote a part of their energies to urging upon farmers the necessity and advantages of co-operative organization, instead of side-stepping the question lest they disturb the equanimity of local middlemen, they would be reaching their object by the most direct and effective means. If our enterprising agricultural colleges would take up the question of co-operation among farmers, their students might return to the country with some sympathy for, and knowledge of, the best means of upbuilding their fathers' business and improving its environment.

[Since the preparation of this article the "North Pacific Fruit Distributors" has been organized, making the largest central selling agency in the Northwest. —Ed.]

CO-OPERATION IN THE HANDLING AND MARKETING OF FRUIT

The handling and marketing of crops through co-operative associations is more highly developed in fruit growing than in any other agricultural industry in America. These organizations are formed to purchase the supplies used in the production and marketing of the crops, to standardize the harvesting, handling, grading, and packing of the fruit, to sell the fruit of the members as a unit under whatever system of marketing is adopted, to prevent disastrous competition by bringing about an equitable distribution throughout the country, and to handle the fruit business in other ways collectively rather than individually whenever it can be done more economically and effectively. There are several hundred of these associations among the fruit growers of the Western states and a number that are successful among the fruit growers in the Central West and along the Atlantic coast.

Co-operation in the West

Fruit growing is a highly specialized industry in the Western states. The growers there have often had extensive business experience before engaging in horticulture. The industry in the West is confined to the valleys and foothills or is more or less geographically localized in other ways. Land values are usually high in comparison with the price of land in the East, cultural practices are more expensive and intensive, the markets are thousands of miles distant, and the problems of production, transportation, distribution, marketing, and legislation are too complex for the average individual grower to meet and solve alone. Under these conditions co-operative effort is a business necessity, just as the consolidation of capital in other industries is necessary for its own preservation. The production, buying, distribution, and selling of crops must be accomplished by working together. Things must be done in a large way if the fruit grower is to deal on the same level with the combinations of capital with which his product comes in contact at every step from the orchard to the consumer. The Western fruit growers have therefore formed associations of various kinds to work out the problems that confront them.

At the foundation of the semi-arid western horticulture lies the necessity for irrigation, and the irrigation systems, which are largely owned and controlled by the farmers, form a common tie which binds them closely together and makes co-operation in other things more easily accomplished than is the case in the humid fruit-growing sections of the East. They may co-operate to protect the orchards from insect pests and diseases or from frost, to pick the fruit, to prepare it for shipment, and to direct its distribution, storage and marketing. They may own outfits for spraying and fumigating, packing houses that cost thousands of dollars, and storage plants of large capac-

ity. They may develop a system of distribution and of market reporting which keeps them in daily touch with the markets in every part of the United States and Canada and with the general movement of fruit in transit. They may advertise their products extensively and through their organizations handle the legislative and other public-policy questions that vitally affect the industry.

Co-operation in the East

In the central and eastern parts of the country the growing of fruit is not usually specialized or localized. It is more likely to be an incidental feature of the general agriculture of a community. It is slowly developing into a specialized industry, especially in many sections of the East and South, though it is still largely in the hands of men whose only experience has been gained on the farm. In the eastern half of the United States, where irrigation is not required, the difficulties of production are more easily overcome, competition among fruit buyers is more or less keen, markets are comparatively close at hand, and the problems of transportation and of marketing are not as acute as they are with the Western fruit grower.

The need of co-operation has not faced the Eastern fruit grower as squarely as it has the grower in the West. Hence, the co-operative movement has been of slower development in the East, except in such industries as grape growing in Western New York and the citrus-fruit industry in Florida, where the stability of the capital invested has been threatened as a result of a haphazard system of individual distribution or of local selling and marketing. Under these conditions there have been formed virile organizations of growers for the distribution and marketing of the products, and such organizations when properly directed have been successful.

The Individualism of the Farmer

Co-operation among farmers is more difficult to effect than the consolidation of capital in other business enterprises. The farmer is the most individualistic of American citizens. It is not easy for him to transact his business with his neighbors. Independence in handling his affairs is a tradition that has been his for generations. He would rather conduct his business man to man, as his fathers have done before him, unless necessity compels him to do otherwise. The co-operative movements that have been organized among prosperous fruit growers have usually failed. The social, the political, or the altruistic motives have not been strong enough to hold a group of money-making farmers together. The only successful co-operative efforts until recently have been those which have been born of desperate necessity.

Co-operation must be effected when the fruit industry is at low ebb to have the virility to live in the face of the attacks to which all such efforts are at first subjected, but after the growers have learned the power of co-operation as a business opportunity, their organizations become permanent and exert a powerful influence in the development of a better social life, and, through their participation in the progress and management of rural affairs, in the development of a better citizenship. No other agency is so powerful in bringing about better farming, better methods of handling the industry, a greater prosperity, and a better community than a group of farmers who are successfully organized to protect and develop their agricultural interests. The American farmer is beginning to realize that the powerful influence of consolidated capital has been the source of the tremendous industrial progress of the last generation. He is beginning to take a greater interest in the possibilities of co-operative action when applied to his own problems.

Fundamental Principles of Co-operation

There are many kinds of co-operative associations among the fruit growers of the United States. In a non-profit association, which represents the ideal type of co-operation, the members usually have an equal voice in its management and share proportionately in its benefits and risks. Such an organization is a voluntary industrial democracy in which

the fruit growers manage and control the distribution and marketing of their own products. Every member of the association is a bona fide producer and his fruit is handled exclusively by the association. All of the operations are carried on at cost, and after operating expenses, depreciation, and a reasonable interest on the capital invested in the equipment of the association are deducted, the profits are distributed to the members in proportion to the amount of business each has transacted through the organization.

The powers of the association are vested in a board of directors selected by the growers, who manage and control its affairs and business through officers or agents appointed by it and subject to its advice and direction.

The Organization of a Co-operative Association

The first step in organizing a co-operative association is to incorporate it under the laws of a state. This usually has to be done under the laws that authorize the formation of stock or membership corporations, as few of the states have provided for the incorporation of non-profit co-operative agricultural or horticultural associations.

The association needs to be incorporated on broad lines. The articles of incorporation should set forth the purpose for which the association is formed and should provide for every activity in which it may wish to engage. They should define the principal place of business, the life of the association, the number and power of the directors, the voting power and property rights of the members, the amount of the capital stock, and all other things of a general nature that are needed to be included in the incorporation of such a body.

A code of by-laws needs to be adopted for the government and management of a co-operative association. The by-laws should define the method of exercising the power of the corporation through the board of directors and the officers appointed by it, the conditions surrounding the admission of members, the dues or stock to be paid by each, and the conditions surrounding the same. They should provide broad powers for the manager, including the supervision of the harvesting, grading, packing, distribution, and sale of the fruit, or for such of these operations as the association may wish to perform. They should define the grades to be adopted by the association for each kind of fruit. They should contain a provision by which the grower gives the association the exclusive right to market the fruit, with the possible exception of the lowest grades, and to harvest, grade, and pack the same. This includes the selling of the fruit for the members either as individuals or through pools of fruit, a penalty to be collected by the association for every package sold outside of the association. These objects are attained by the signature of the farmer to the by-laws of the association, or the association may require a special contract to be executed with the co-operating member.

The methods of providing money for operating expenses, such as a fixed assessment against every package of fruit handled by the association, and the method of prorating the balance if the total amount of the package assessment amounts to more than the operating expenses, and other things usually included in such organizations should be set forth in the by-laws.

Types of Co-operative Associations

The fruit growers' organizations vary in form from joint-stock companies composed of growers or dealers or of both, who distribute their own products or the products of others, to the simple non-profit form of co-operative association which purchases the supplies and distributes the products of its members at cost. The voting power of the members in the different associations varies from a single vote for each member to a vote proportional to the amount of stock owned by each or to the acreage held by each. His voting power may depend on the probable crop production or the actual production of the preceding year. The capital may be contributed in limited amount equally by each member in

proportion to the acreage held by each or to the probable production of each member, or unequally without reference to either of these factors. It may be contributed by business men who are not fruit growers, but who desire to encourage the formation of associations; or the capital stock may be subscribed as an investment, and a high rate of interest paid on it before the profits are distributed to the growers. Some of the associations handle fruit on speculation or for non-members at a specified rate per package.

All of these types of so-called co-operative associations and many others are in operation with a greater or less degree of success. The most virile and effective from the standpoint of the producer are those which are strictly co-operative, non-profit in type, each member contributing an equal amount of capital and having an equal voice in its management or a voting power and capital contribution in proportion to the acreage of bearing fruit held by each. The association handles the fruit of the members only and the fruit is under the control of the association from the tree to the market. The objection urged against this form of organization is that the small grower has an equal voice with the large grower in fixing the policies of the association. The objection to the voting power based on acreage is that the exceptional grower has no more influence than a poor grower of equal acreage. There is equally strong objection to the form of power based on production, as the pro rata of production may vary with the seasons. All of these objections are discussed in the following pages.

Causes of Failure in Co-operative Associations

Not all of the co-operative associations are successful. In fact, comparatively few of them have been distinctly successful, especially among the early associations formed before the citrus-fruit growers of California organized to distribute their products and to protect the capital invested in their industry. The citrus-fruit organizations, most of which are founded on the true co-operative, non-profit basis, have had a far-reaching influence on the co-operative movement in the United States.

The orange and lemon growers of California have the most powerful and successful organizations to be found in any agricultural industry in the United States, if not in the world, one organization acting as an agent in distributing $15,000,000 worth of fruit a year for its 6,000 members, organized into more than a hundred associations on a non-profit basis. This agency sends fruit to every part of the United States and Canada and to several foreign countries, maintaining its own exclusive representatives in all of the principal markets of America. Many of the co-operative associations organized in recent years have been formed on the principles that underlie the citrus-fruit associations, and these, when wisely managed, have shown great strength.

The Management of a Co-operative Association

Several factors have contributed to the downfall of fruit growers' associations. Many of them have been formed by impractical, often unsuccessful, enthusiasts with high motives, but with no business experience and little standing in their communities. Others have been formed ahead of their time when the industry was too successful for the members to be held together. Many of them have been managed by incompetent, low-salaried men, not infrequently by those who have been unsuccessful in business. The successful handling of a co-operative association requires a manager who is competent to assume the general direction of the affairs and business of the association. He must have a high order of business ability, sterling integrity, unusual tact and judgment in handling men, and unlimited energy. An association under any other kind of management is not a serious business undertaking.

It is more difficult to direct a co-operative association than a stock company or corporation. In the latter the manager is responsible to a board of directors, but the stockholders do not often

take an active interest in the management of its affairs. In the co-operative association the manager is also subject to the advice and control of the board of directors, but the farmer who joins with his neighbors in an association is likely to take more than a passing interest in the management of the association. A manager who cannot hold the interest and the confidence of the members, who fails to develop a progressive, constructive business policy, will fail in handling a co-operative organization. Nor can such an organization succeed if the directors do not realize that it must have a strong, competent, aggressive, well-paid manager at its head. It is not too much to say that no single factor has operated against the success of the co-operative associations as much as the incompetent managers selected by the directors of the associations to handle them. A board of directors cannot manage a co-operative agricultural association. The outcome of the organization will be determined in large degree by the character and ability of the manager.

The Payment of Dividends

Another factor that has operated against the success of many so-called co-operative associations has been the payment of high dividends on the capital invested, the stock having been subscribed unequally by a comparatively few members. The organization in which the business is not transacted at cost cannot hold the confidence and support of its members. The payment of one or two high dividends on the capital stock before the proceeds are distributed to the growers has caused the downfall of many associations that have been well organized in other respects. Another dangerous element has been the ambitious effort of new associations to buy and sell fruit and supplies outside of the membership. The speculative element must be rigidly excluded from co-operative associations. The harvesting, grading, packing and handling of fruit not grown by members invariably leads to a lowering of the established standards of grading and packing and to injury to the reputation and financial standing of the association.

Disloyalty of Members a Cause of Failure

Many co-operative efforts fail through the disloyalty of members when the association is subjected to the skillful, insidious fire of those who oppose it. The farmer is not used to having his business attacked, and those who are interested in disrupting the organization appeal directly to his pocketbook by attempting to show that the association does not realize as much for the fruit as the farmer could realize outside the association. They also persistently insinuate that the association is grossly mismanaged.

It is a favorite practice of the opponents of co-operative distribution and selling to offer association members a premium on their fruits. The apple grower is tempted by a premium of 25 to 50 cents a barrel over the probable return of the association; the peach grower by an advance of 10 to 20 cents a box or basket, and the pear or small-fruit grower by an equally attractive bonus. The man with a small crop and a still smaller capital often falls before this kind of temptation, and if it is held out long enough the association may be disrupted. These devices are coming to be well understood and the fruit grower who joins an association in good faith and sells out for a small premium is in danger of losing the respect and confidence of his neighbors.

The Membership Contract

It is a fundamental necessity that the members be held together by a contract or a provision in the by-laws which gives the association the exclusive right to pick, pack, haul, grade, mark and sell the fruit of its members, or to perform as many of these operations as it may decide to perform, or to supervise or regulate these operations under rules made by the association. The contract should be drawn for a term of three to five years, giving the grower the privilege of withdrawing by notice at the end of

any fruit year, thereby making his continued connection with the association voluntary. The contract should specify a penalty to be assessed against every package of fruit sold outside of the association, this penalty to equal not less than 25 per cent of the value of the fruit. Under any other plan an association cannot build on a solid foundation. It cannot foresee the probable volume of business to be transacted, nor can it provide the means to purchase the supplies for handling the crop or reach that degree of stability that is essential to the success of a business undertaking. The membership contract with the grower is the foundation stone on which the business of the association is reared and without which its existence and stability are problematical.

Co-operation in the Purchase of Supplies

In every co-operative association there should be a division for the purchase, sale or manufacture of supplies of every kind used in the production, packing, handling, shipping and marketing of the crop. The association should be prepared to purchase fertilizers, materials and equipment for spraying and fumigation; the facilities used in frost protection, pruning or harvesting; orchard machinery, or any other equipment on which a saving can be made by co-operative purchasing. It should be prepared to purchase the supplies for fruit handling and marketing, such as box shooks or packages, picking boxes, nails, wrapping paper, and all kinds of packing-house equipment.

The money needed to operate this purchasing division may be raised by assessment, by the individual notes of the directors of the association, or in other ways. The association should sell the supplies to the members at a fair market price, and at the end of the season should prorate the surplus to the members or invest it in the business, after deducting the operating charges, depreciation and other necessary expenses, including interest on the assets and capital devoted to this supply division.

Co-operation in the Handling of Fruit

The condition in which fruit reaches the consumer depends largely on the care with which it is handled. The most common rots of apples and pears, of small fruits, and of citrus fruits are directly related to the mechanical bruising of the fruit, most of the diseases not having the power of penetrating a healthy, uninjured skin. The association must therefore provide rigid rules for picking. It must either supervise the harvesting, grading and packing of the fruit and provide for the most rigid inspection of every lot before it is accepted by the association for shipment, or else the harvesting, grading and packing must be done by the association. In most of the associations where the fruit is not packed in central packing houses it is picked and packed by the grower according to the rules of the association, and inspected by an employee of the association before it is accepted for shipment.

This system works fairly well with the small deciduous fruits, which have to be handled quickly from the field to the consumer. It is not a satisfactory system to apply to the citrus fruits or to the apple or pear crops. With these the handling, grading and packing must be standarized, and this can be done only when the association controls all of the handling operations or actually performs them. Many apple associations establish rules of grading and packing. The association grower picks and packs the fruit, and the association accepts or rejects it by inspecting the packages when delivered at the railroad station, the association warehouse or some other point. But experience has shown that the grower can rarely be depended on to pick and pack the fruit in the best manner. It requires skilled labor, and fruit grading and packing is an art that is acquired by few individual fruit growers. An association, therefore, that operates on this principle seldom reaches the highest degree of success, and is likely to fail outright. A better plan is to have the grower pick the fruit when directed to do so by the

association. It is then graded and packed according to the rules of the association in the orchard or in the fruit house on the farm by trained men in the employ of the association. Under this plan the grading and packing of the fruit of the entire membership can be done with comparative uniformity. Even then the packages need to be inspected before they are accepted by the association. Every package rejected should be regraded and repacked or placed in a low grade. This system is in operation in several of the most successful co-operative apple growers' associations in the United States.

Another plan is to grade and pack the fruit at a central packing house owned and controlled by the association. The growers pick the fruit, haul it to the packing house, and there it is graded and packed by the association. This is the plan that was formerly in general operation in the orange and lemon-growing districts and is followed to a limited extent at the present time. The objection to this plan is that no two growers handle the fruit with equal care, and the different lots of fruit therefore vary in physical condition and in susceptibility to decay. Under this system there is a wide variation in the percentage of decay that develops in the fruit of different members while in transit to market. If the fruit is pooled, the grower who handles his fruit carefully has to share the losses that develop in the fruit that has been carelessly handled.

The most satisfactory plan in the citrus-fruit industry (and this may be applied to some other fruits) is to have the association train gangs of laborers who shall pick the fruit of all of the members. The laborers should be paid by the day, as contract or piecework places a premium on rapid, careless work. In this way the picking can be standardized, the quantity of fruit that passes through the packing house can be controlled, and the grading and packing can be uniformly done.

This system has been generally adopted in the citrus-fruit industry as a result of the investigations of the Department of Agriculture into the causes of decay in oranges and lemons while in transit from California to the East. This investigation showed that the decay was the result of the improper handling of the fruit in preparing it for shipment, and that it could be controlled by placing the handling of the fruit entirely in the hands of the associations. The same laborers often fumigate the orchards of the members for scale insects and spray the trees wherever spraying is practiced.

The Central Packing House

The tendency in the co-operative movement is toward a central packing house where the fruit of the members is brought together and is graded and packed for shipment. In the small-fruit industry this plan is hardly practicable. It is sometimes successfully operated in the deciduous-fruit and in the grape industries. There are about 200 of these association packing houses in the citrus industry in California, and the Florida citrus growers are rapidly organizing along these lines. A packing house is erected by the association, usually alongside the railroad, and is equipped with the necessary appliances for fruit handling and packing, the manager of the packing house being usually the general manager of the association. Precooling and cold-storage plants, box-nailing and labeling machinery, and other devices required in the industry, are to be found in many of the association houses.

The Pooling of Fruit

There is a growing practice in the co-operative associations to pool and sell the fruit as a common commodity under the brands of the association rather than to sell the fruit of each grower separately. The pool is an arrangement by which the similar grades of fruit of all of the growers are united and sold together. At the end of a pool, which may vary from a daily pool in the summer-fruit business to a monthly or semi-monthly pool in the citrus-fruit business or a season pool in the apple industry, the grower receives his pro rata

of the proceeds based on the number of pounds or packages of each grade that he has contributed In theory the grower has the privilege of contributing to each pool his pro rata of the fruit of the association as a whole, the manager of the association usually apportioning to the growers their quota in accordance with their respective acreage. The pooling arrangement greatly simplifies the practical business methods of the association.

The successful working of the pooling system depends on having the handling, grading and packing of the fruit under the direction or control of the association. It may but does not often succeed where these operations are in the hands of the grower. It depends, further, on having a large proportion of the fruit of the association of uniform grade. There is considerable variation in the average quality of different lots of fruit in the same grade, even under the most rigid system of grading. The fancy grade of one grower may average better than the fancy of another, though the fruit of both is entitled to be graded fancy under the established rules of the association.

No grower is willing to admit that he does not raise the best fruit in his community, and where it happens that his fruit falls below the average and he is paid for a larger proportion of the lower grades than his neighbor he may become dissatisfied, when he will either drift along and finally leave the association or will adopt better cultural methods. In some communities there is a friendly rivalry among the association members in securing the largest proportion of the higher grades of fruit. The grade of fruit grown under similar conditions of soil and location depends largely on the cultural skill of the grower, and the publicity that the association affords regarding the results of grading the fruit of different growers is a strong factor in stimulating better cultural methods in a community as a whole.

On the other hand, the pooling system may not encourage the unusually skillful grower to develop fruit of the highest average grade. If he stands alone as a skillful grower, he will not get the full advantage of his extra-fine fruit in the pool, as the practical effect of the pool is to lower the price of extra-fine fruit and to raise the price of fruit that can barely enter a grade. An association ought, therefore, to be composed of members located similarly as to soil and other physical conditions and having similar cultural skill and, preferably, similar acreage. Unless these fundamental conditions are carefully guarded, the pooling system may tend to lower the average grade of the fruit of a community because the grower, realizing that the identity of his fruit is lost in the pool, may grow careless in his cultural practices and trust to the better fruit of his more careful neighbors to raise the average net returns of the grades in which his fruit is pooled.

The Size of a Co-operative Association

In theory a large association can handle a business more economically than a small one. It is not usually practicable, in the orange business for example, to organize an association and build a packing house unless there are at least 150 cars of fruit to ship. The largest associations do not often ship more than 750 cars, and only a few of these large associations are highly successful, as they are likely to become unwieldy and difficult to hold together.

There is a wide difference in the character of the fruit grown on different soils at different altitudes or with other dissimilar physical conditions. The variation shows in the texture of the skin, in its color and clearness, in the flavor of the fruit, and in those qualities which give it style and attractiveness. There is no system of grading by which the fruit grown under different conditions can be made uniform and similar. An association should therefore include not only those growers who are similarly skillful, but also those whose fruit naturally shows similar characteristics.

In a community in which the fruit is somewhat variable it is a wiser policy to organize several associations, each

with its brands of fruit, than to attempt to market all of the fruit under the same brand through one organization. These organizations may act independently in the purchase of supplies and in the marketing of the fruit, or they may federate and form an agency to act for them in the distribution and marketing of the fruit, in the purchase of supplies, and in promoting the co-operative movement in other ways. It is only under this method of organization that the co-operative association can reach its highest development of better methods of fruit growing and in rural development.

The Organization of the Citrus-Fruit Industry of California

The citrus-fruit industry in California, which has developed commercially since 1873, when the Washington navel orange, originally grown in Brazil, was sent to Riverside by the United States Department of Agriculture, represents an investment of 150 to 175 million dollars. The annual shipments of oranges and lemons have reached the enormous total of 40,000 to 50,000 carloads, with a value in California estimated to vary from 20 to 30 million dollars. Between 125,000 and 150,000 acres have been planted to citrus fruits, and from 100,000 to 150,000 people depend on the industry for a livelihood.

The industry is localized largely in Southern California, though it is extending rapidly in the interior valleys to the north. No other horticultural industry in the United States of equal extent is so compactly located. None presents more difficult problems or requires a more skillful distribution and marketing of the crop. Oranges and lemons are distributed from California practically every day in the year for distances of thousands of miles to all of the important cities and towns in the United States and Canada, and some are exported to other countries.

When the industry was small no complicated problems of distribution or marketing faced the grower. The fruit was sold for cash to buyers on the ground or to brokers who represented distant commission houses or other interests, or it may have been sent direct to a commission firm in some far-away city. As the industry grew larger and there were several thousand carloads of fruit to sell, the grower began to realize that the systems of selling the fruit already in operation were inadequate to bring to him the proportion of the returns which his capital was earning and to which he considered himself entitled. Under the system in operation there were frequent gluts in a few of the markets and apparently no effort among the buyers to equalize the distribution of the fruit geographically or throughout the year. The buyers were said sometimes to have fixed the maximum price which would be paid the grower and to apportion the citrus-fruit area into districts so as to reduce competition among themselves. The result was disastrous to the producer and became so serious in the early nineties as to threaten to wipe out the capital invested in the industry.

About this time the growers began to organize small associations for the purpose of preparing the fruit for shipment, and in order that it might be assembled in quantity and sold for cash or shipped as a unit. Mr. T. H. B. Chamblin, of Riverside, was the pioneer in organizing the citrus-fruit growers of Southern California. The Pachappa Fruit Association was the first one formed, about 1888. A number of these growers' associations were soon formed, and in 1893 a plan was outlined by Mr. Chamblin, and finally adopted in principle, which federated a number of the associations and provided for the preparation of the fruit for market by the local associations, for the organization of district exchanges to be made up of the local associations, which were to receive orders for the fruit and apportion them among the associations, it being the intent at that time to ship only such fruit as was sold before picking, and the formation of an executive committee, made up of representatives from the district exchanges, to market the fruit.

Out of this federation grew the Southern California Fruit Exchange in 1895, and later, in 1905, the California Fruit-

Growers' Exchange, which now handles about 60 per cent of the citrus fruits grown in California. There are many other associations of growers not connected with the exchange which are organized on the same general principles, and these associations, together with the exchange and a few large growers who market their own fruit, handle about 85 per cent of the citrus-fruit crop.

In order that the principles which underlie the largest co-operative fruit-marketing organization in the United States may be understood, a brief outline of the exchange system follows:

The California Fruit-Growers' Exchange represents about 6,000 growers who have organized themselves into 100 or more local associations. The association usually owns its own packing house, where the fruit of the members is assembled, pooled and prepared for market under brands adopted for the different grades by the association. The association usually picks the fruit of the members.

The associations in the different regions combine into one or more district exchanges which represent the association in the business operations common to each and which sell the fruit in co-operation with the California Fruit-Growers' Exchange through the district or local agents of the latter or at auction, receiving the proceeds therefor through the California Fruit-Growers' Exchange, an incorporated agency formed by a representative of each of the sixteen district exchanges, which acts as the selling agent for these district exchanges. The California Fruit-Growers' Exchange takes the fruit of the district exchanges after it is packed and with their advice places it in the different markets, sells it through its own exclusive agents to the trade or by auction, and collects the proceeds and transmits them to the district exchanges, which in turn pay the growers through the local associations.

The central exchange, the district exchange, and the association all transact business for the grower at actual cost. The central exchange through its agents is in daily touch with the markets of America, thereby enabling it to distribute its fruit intelligently. The local exchanges and the associations receive a daily bulletin from the central exchange which outlines the condition of all the markets the preceding day, states the selling price of all exchange cars, and gives the growers such information as will help them to pack and distribute their fruit to the best advantage.

The limits of this article are too restricted to permit more than a brief outline of the battle that the citrus-fruit growers of California had to wage for fifteen years before the co-operative principle was on a firm foundation. At first the growers were inexperienced in meeting the attacks of those who were opposed to co-operation among the producers. Powerful financial interests of various kinds were arrayed against them and were organized to oppose them. Vicious attacks were made on the integrity of the officers. The results obtained by the associations were belittled, the growers' association contract was assailed in the courts, and the methods of marketing the fruit were attacked. The most determined efforts were made to show that the growers' organizations were illegally formed. Finally the growers combined with the buyers at one time to market the entire crop, but this incongruous combination of producers and dealers was dissolved at the end of a year and a half.

The history of the citrus industry in California is largely a record of the progress in the co-operative handling and distribution of the crop by the producer and of his determination to receive an equitable share of the value of the labor expended in its production. The battle has been won; the co-operative principle is firmly fixed. It is the balance wheel that gives stability to the industry and to the relations that exist between it and the agencies with which it transacts business.

Fewer serious efforts are made now to break down the co-operative principle among the growers. New schemes of fruit-marketing are proposed from time

to time, the organizations are frequently attacked in the courts under one guise or another, and other insidious movements are started, all having in view the possible splitting open of the co-operative organizations and a return to the methods of marketing which would destroy the systematic distribution and marketing now in operation and reinstate the chaotic speculative methods that were formerly in vogue. The co-operative movement in the citrus industry is the result of a slow, painful evolution, and the grower does not appear to be deceived by these efforts, no matter how ingeniously and artfully they are conceived.

Selling the Fruit by Co-operative Associations

The co-operative associations sell the fruit in a variety of ways, the method of sale depending on the character and condition of the industry and the practices that have grown up around it. A large proportion of the deciduous summer fruits is sold f. o. b. cars at the point of production, subject to inspection on arrival in market, or for cash f. o. b. cars, or at auction. Some are consigned to commission merchants. From 25 to 30 per cent of the citrus fruits of California are sold at public auction in the Eastern and Central Western markets, and a large proportion of the Western deciduous fruits is sold in this manner. Among the apple associations it is a common practice to send to the trade in advance of the harvest a catalogue of the probable number of boxes of the different varieties and sizes of the higher grades of fruit that the association has for sale, and finally to sell the fruit to the highest f. o. b. bidder. The lower grades are consigned to commission firms, are sold for cash, or are marketed in other ways.

Few of the organizations, except those that transact a large business—like the citrus-fruit growers of Florida and California, the peach shippers of Georgia, and the deciduous-fruit shippers of California—have attempted to regulate the distribution of their products throughout the country, nor have any serious attempts been made to carry the distribution beyond the wholesale dealer, the broker, or the auction companies. The co-operative method has brought about large economies in the purchase of supplies, in the cost of preparing the fruit for shipment, and in the charges for distribution and sale. It has improved the methods of fruit packing and grading enormously. It has sometimes doubled the net returns to the individual grower for his product. The difference in the price that the association receives for the fruit and that which the consumer pays is often 100 per cent or more higher than the original selling price, and this contracts consumption.

As long as the country is prosperous and the present method of distribution and sale does not cause a disastrous over-supply in the principal markets, the growers will be satisfied to continue the methods now in operation. But as the fruit business increases it will be necessary for the growers' associations to develop methods for increasing consumption. This will be accomplished by a more general distribution of their products, by the development of their associations into marketing organizations, by equalizing the distribution of the fruit over a longer period through a greater use of cold-storage warehouses, by stimulating a greater interest in fruit consumption through systematic advertising, and by placing the fruit in the consumer's hand at a cost nearer that which the producer himself receives. As the American fruit business increases, the grower may be expected to bring about as great an improvement in the methods of distributing and selling his products to the consumer as he has already accomplished in the handling, grading, packing and preparation of the fruit for market.

G. Harold Powell,
Pomologist and Acting Chief,
Bureau of Plant Industry
(1910 Year-book)

YAKIMA VALLEY FRUIT GROWERS' ASSOCIATION

FRANK E. SICKLES,
General Manager.

The Yakima Valley Fruit Growers' Association was organized in the fall of 1910. It was the outgrowth of a widespread feeling among the fruit growers of the valley, who faced the fact that an enormous acreage had been planted to fruit trees which would soon come into bearing, that only through co-operative effort and organization could a solution of the marketing problem be found and the industry placed upon a permanent business basis. Their purpose was expressed in the preamble of the articles of incorporation which were filed November 7, 1910:

"We, the undersigned, realizing the advantages to be gained by drawing more closely together the fruit growers of the Yakima valley and the advantages that may be gained by co-operation and unity of action among said growers, and for the purposes of cementing the business relations which should exist among the fruit growers as a class, to the end that they may all work together for their mutual interests in securing the most favorable markets for their products, and in attaining the highest standard of quality of fruit shipped from the Yakima valley, do hereby agree to form an association or corporation for mutual advantage, and not for profit, and to that end hereby make and subscribe and do hereby adopt the following articles of incorporation, to-wit:"

The list of the first-year directors, with their residences, shows that from the first the organization was valley wide, bringing together, perhaps for the first time, into united and harmonious action, men living "above the gap" and men living "below the gap," phrases which will be familiar to Yakima people. Following is the list:

E. M. Sly, Kennewick; B. D. Thompson, Granger; J. E. Shannon, Geo. E. C. Johnson, North Yakima; John Dobie, Lower Naches, and M. E. Olson, Parker.

The plan of organization which was adopted and which we outline below, is the work very largely of Mr. N. C. Richards of North Yakima, who has been from the beginning general counsel for the association; and its successful development and application to practical business has been the result in great measure of the organizing skill, tireless energy and unfailing faith of Mr. J. H. Robbins, who until June, 1913, was general manager. The association is generally recognized as one of the most successful of all co-operative organizations and has already served as a model for many other such enterprises; a somewhat full account of its plan may be of value to fruit growers everywhere.

The organization is incorporated under the provisions of the so-called "Fraternal Lodge Law" of the State of Washington; and the fact is suggestive of the spirit, purpose and method of the organization As a corporation it is therefore what is known in some states as a "membership corporation" as distinguished from a "stock corporation."

No Capital Stock

The association has no capital stock. The reasoning which controlled the action of the organizers may be stated somewhat as follows: Many of the evils which have sprung from the tremendous growth of modern corporations have had their origin in the fact that there are two distinct sets of interests and measures of values in every corporate concern, the business itself and the stocks based upon it; and the two are often by no means identical; when the concern grows large two distinct lines of enterprise spring up, the conduct of the corporate business and the flotation and manipulation of the stock. This segregation of interests attaching to stock from those attaching to the business itself they believed to be especially dangerous in a growers' marketing organization, for the peculiar conditions, relations, needs and purposes of the business emphasize the danger at every point. The growers' only interest in the organization is to secure through it the maximum of returns at the minimum charge; the stock-

holders' only interest is to do a maximum of business at a maximum of profit—which means a maximum charge to growers, modified only by the necessity of making the charge low enough to secure the business. The stockholders' interests and the shippers' interests are not and cannot be made to be anything other than essentially antagonistic. Experience has shown that it is practically impossible to remedy this condition by any system of stock control or limitation. A right start may be made in a growers' stock organization but the shifting chances of time will soon bring in a condition where combinations of stockholders can control the corporation against the interests of the growers, and the very common spectacle will be exhibited of a growers' co-operative organization controlled by non-growers. By making the basis the man with his tonnage and not dollars invested in stock all these difficulties are avoided.

Non-Profit Making

The association cannot do business at a profit. Under the terms of its charter it must perform its services for the grower at cost. Its charges for any season must be based upon the necessities of the budget for that season, and if any surplus remain at the close of the year, it must be returned to the members. This assures the growers a sales-service at cost, removes the temptation to build up a large surplus in the organization by making excessive charges and makes it impossible for the association to perform services for non-members or to go into a general mercantile business to the possible endangering of its legitimate purposes.

Membership

Any person who is the owner or lessee of lands set to any kind of merchantable fruits is eligible to membership upon complying with two conditions: 1st, signing a contract for the marketing of his fruit, which will be referred to again more in detail; and, 2nd, paying or binding himself to pay the membership fee. A certificate is issued to each member which is not transferable except to a lessee or grantee of the land owned by the member and described in his crop contract. It can, therefore, at the option of the member, "go with the land" or follow him and attach to other land of which he may become the owner or lessee. If he sells to another member, the certificate may be turned into the association and reissued to the next grower applying for membership, the membership fee to be turned over to the retiring member. In case a member ceases to be a grower, his certificate may be cancelled.

The certificate entitles the member to all the privileges of the association so long as his crop contract continues in force. Should he withhold his crop from the association for any reason, he loses his right to any and all privileges of the association, but can afterwards renew his contract and be restored to the enjoyment of privileges upon the basis of the same certificate and fee.

Membership Fee

Every member pays a membership fee of $100. In what manner this is paid rests entirely in the hands of the district associations; it may be paid in cash, secured by notes payable as suits the conditions of the growers, or by making a percentage deduction from the member's crop returns; the plan is very flexible and admits of adjustment to the peculiar conditions of each district and individual. These membership fees are usually devoted by the districts to providing local warehouse facilities.

Crop Contract

This is a tripartite agreement between the grower, his district association and the association. By it the grower agrees to market all his fruit grown on the land described in the contract through the association, and agrees to pay for marketing, loading and such selling charges and commissions as may be necessary in order to meet expenses. The contract is perpetual and continues from year to year unless cancelled by the grower on March 1st of any year, after giving twenty days' notice in writing of his inten-

tion to cancel. It provides for liquidated damages to be enforced against the grower who violates his contract. The contract also authorizes the association to withhold from fruit returns all association charges and all amounts due for supplies furnished the member.

Federal Plan

The association is organized on the federal plan first worked out so successfully by the California Fruit Growers' Exchange. A somewhat close analogy can be drawn between it and our American form of government, which begins with the town or county, passes up into the state and ends by federating the states into one national government. In the association, the units are the district associations, which are all brought together and federated in this association, commonly known as the "Central"; or, since the organization of the North Pacific Fruit Distributors, as the "Sub-central." Again this association is federated with the other districts of the Northwest in the distributors, which thus becomes the "Central."

The district associations are all separately incorporated under the "Lodge Law" and are independent, self-governing organizations, without capital stock, and under the terms of their charters obliged to do business only for their own members and to do it without profit; they are thus, like the sub-central, purely co-operative. It is the plan of the association to strengthen and build up the district organizations into well-governed, business-like bodies, independent and thoroughly competent to care in the best possible manner for local affairs. In pursuance of this policy, the trained experts in charge of sub-central's departments are always at the service of the districts for counsel and guidance, and responsibilities are placed upon them wherever practicable. Community interests are cared for—illustrated by the fact that the association does the district business through the local bank authorized by the district.

Government

The growers hold their membership immediately in the district associations, naturally choosing the one whose shipping facilities best serve their individual purpose. The members elect the trustees, each member having one vote which he may cast either in person or by proxy; the trustees elect the officers, appoint the manager and of course constitute the active governing body of the district. The trustees elect from their number two "representatives to sub-central." These representatives from each district constitute the board of trustees of the association, in whose hands rests the entire management of its affairs. These trustees elect the usual officers and appoint the general manager, and other necessary executive officers. As the board of trustees is a large and somewhat expensive and unwieldy body, it elects an executive committee of seven members, consisting of the president and six other trustees fairly representative of the different divisions of the valley, which meets at least every month and constitutes the every-day business end of the management so far as the growers are concerned. The members of the executive committee receive their expenses and a per diem of $5.

Functions of the District

All purely local affairs are cared for by the districts; this includes warehousing, consolidating less than carload shipments by different members, and distribution of supplies. The districts may, and many of them do, add to these necessary things such other helpful activities as they think wise under their local conditions. Under their charters they are permitted to undertake any co-operative enterprise for their communities that the members wish. By this principle of home rule local interest and pride is aroused and the individual members are kept in closer touch with their organization. The settlement of all local issues is then left to the local growers.

Functions of "Sub-central"

Broadly speaking, the sub-central receives the fruit when loaded and has charge of shipping, marketing and collecting; it consolidates less than carload shipments from the districts; it buys all

supplies and distributes them to the districts; it maintains an inspection department to secure absolute uniformity in grade and pack throughout the valley; it takes care of all purely inter-district matters, and looks after the organization of new districts; it distributes all returns to the growers and makes the deductions in payment of supply accounts.

Functions of "Central"

The North Pacific Fruit Distributors are general sales agents for the association and handle all carload shipments.

Supplies

Thus far the association has attempted to handle no supplies for its members except such as may be classed as strictly orchard supplies, sprays, boxes, paper, nails, etc. Contracts and purchases are made by the sub-central and distributed through the districts. Each district is held responsible for all supplies furnished through it to its members. Supplies are sold to members at current retail prices and charged to the district at cost price plus a charge intended to cover sub-central's expense in handling the business. The balance of the difference between cost and sales price thus passes into the hands of the district, where it may be disposed of as the members of each district may direct. Pro rata deductions are made from the crop returns of members in payment of their supply accounts. For the two seasons of 1912 and 1913 the association handled $360,000 worth of supplies, paying for them at or before maturity. The business methods thus indicated and the large amounts purchased make it possible for the association to buy at very low prices.

Financing

In the inception of such a co-operative enterprise, perhaps the most serious problem to solve is that of finance. Organization and promotion work is costly; much of the work each year must be done before the shipping season begins and until that time no revenue is available. Moreover, at all times a working capital is essential, and co-operative enterprises have often found it difficult adequately to meet this need. At the outset the association met the difficulty in two ways: First, the membership fee of $100 was divided between the district and the then central, thus furnishing to central an immediate fund for initial expenses. In April, 1912, this rule was changed and since that date central has received no part of the membership fee. Second, in order to furnish the new organization with a basis for credit, each early member gave his note to the association in an amount equal to $10 for each acre planted to fruit. These notes, known as "acreage notes," were given to be used as collateral under conditions laid down in the by-laws. In April, 1912, the giving of these notes was discontinued and in February of 1913 the association, having no further need of the notes which had been already accumulated, and which aggregated in amount over $60,000, cancelled and returned them to the makers. At the time these changes in the financial plan were made, a plan was adopted which makes provision for the financing of the association in a far more permanent and satisfactory way. Under this plan, a box deduction is made from the returns of all fruit shipped through the association; for apples and pears, 5 cents a box; for peaches and prunes, 1½ cents a box, and for other fruit proportionate amounts; those deductions are considered as a loan to the association and are represented by notes, due three years after date with 4 per cent interest coupons attached. The first two seasons' business has brought into this surplus fund the sum of $85,000, this with another year's accumulation will provide a sufficient working capital, furnished by and belonging to the growers in the exact proportion in which they from year to year make use of the privileges of the association; in case they for any reason sever their connection the capital contributed by them is automatically returned to them as the notes mature.

The current running expenses of the association are met by the usual system of charges upon fruit handled.

Pooling

In the first two seasons the association had no general system of pooling. In 1913, a general pooling system was adopted and now prevails. Soft fruits are pooled by districts while for winter apples there is one season's pool covering all districts.

Warehousing

The association now operates twenty-six warehouses, located in the different districts, which afford large common storage facilities. It has planned a series of cold-storage plants to be owned and operated by the association. The first unit is located at North Yakima, and provides cold storage for 120 cars, besides extensive common storage and general warehouse facilities for handling supplies and fruit shipments The second unit is now nearing completion at Zillah; it will provide cold storage for 550 cars, ice-making capacity of 10,000 tons annually, and car pre-cooling trackage for 14 cars at a time.

Advances

Another serious problem which presents itself to co-operative marketing organization is the financing of its growers. Money is needed by the individual grower to carry on preliminary orchard operations; more money is needed to harvest the crop, and after it is delivered to the warehouse it is often difficult for him to wait for the return of his money from the markets and the closing of pools. To meet these needs the association has gradually developed a three-fold system of advances as follows:

(a) Advances for spraying, thinning, general orchard labor and payment of water assessments prior to delivery of fruit. Application for these must be made at the district office; the orchard must be inspected and the loan guaranteed by the district; a second inspection is made by the association's field department and the advance, if made, secured by interest-bearing notes and crop mortgage.

(b) Advances on delivery of fruit. These are made by the district managers upon request as soon as each load is delivered; the amount per box is fixed by the sub-central office from time to time. The purpose of these advances is to provide the grower with money for harvesting expenses. No interest is charged.

(c) General advances made on the basis of fruit delivered. Application is made at the district office and forwarded to sub-central office for action. These advances also draw no interest.

Growth

The association was organized in the fall of 1910. During the season of 1911 it shipped 300 cars and ended the year with 328 members; in 1912 it shipped 2,020 cars and ended the year with 689 members; in 1913, a short-crop year, it shipped 1,300 cars and ended the year with 964 members; it now has 25 affiliated districts and the membership is well past the one thousand mark.

NORTH PACIFIC FRUIT DISTRIBUTORS

H. C. Sampson,
Secretary-Treasurer.

Introduction

Experience and observation convince all intelligent persons that under present conditions no great business or industry can succeed without such organization and such intelligent management and direction as will result in the largest volume of business attainable at a minimum of expense.

As soon as the growing of deciduous fruits in the Pacific Northwest began to assume large proportions, it became apparent to the thoughtful persons interested in that industry that if our more than two hundred million dollar investment was to be preserved and become the great factor of our agricultural and commercial world that was anticipated, some means must be devised to bring the growers together into an organization for their mutual protection, and to provide a method whereby the product could be standardized and so sold as to eliminate, so far as possible, the element of waste in assembling, and unnecessary cost in selling and distribution; and whereby the con-

sumer might receive his fruit at a lower price, which would increase consumption and thus secure an outlet for our ever-increasing tonnage.

From time to time, at different places where fruit growers congregated, much discussion and feeble attempts to bring about the above results had been made. But nothing tangible was accomplished until at the Growers' Congress, held November 11 to 17, 1912, at Spokane, Washington, in connection with the Fifth National Apple Show, in a meeting at which were present hundreds of the best-known growers and heads of growers' unions, bankers, transportation men and others, it was decided to call a convention of delegates of the growers from the four Northwestern states to meet at Spokane December 16, 1912.

On this date over four hundred delegates, representing all the fruit-growing and producing districts in the Northwestern states, met and decided to undertake the organization of a central selling and distributing agency, and a committee of nine was appointed to outline a plan. This committee recommended that the four Northwestern states be divided into nine sections, which would represent the principal fruit-producing districts; that each of these sections elect a representative, and that such representatives organize and direct a central selling organization. The plan recommended by the committee was unanimously adopted by the convention of delegates and the committee was authorized to proceed with the perfection of such an organization.

Acting under these instructions, the committee on December 17, 1912, incorporated the North Pacific Fruit Distributors, a purely mutual corporation organized without capital stock under the non-profit corporation laws of the state of Washington, the members of the committee acting as incorporators and as a temporary board of trustees.

On March 21 and 22, 1913, the incorporators and trustees held a meeting at North Yakima, Washington. Present by invitation of the trustees at this meeting were many representative growers from all of the Northwestern states. After two days and two nights of most earnest discussion, a preliminary organization was effected.

It was apparent that for the various fruit districts of the Northwest to continue marketing their crops in sharp competition with each other meant disaster to the industry. Fortunately, most of the principal growers and shippers fully realized the situation and began a diligent study of a practical plan for overcoming the jealousies and prejudices that existed in the different districts. When the time came for permanent organization, the board of trustees, with the assistance and guidance of general counsel, adopted a code of underlying principles for by-laws, which had stood the test of the large California and Florida citrus organizations, and which had saved that industry from disaster in those states. The details of that plan were modified to meet the requirements and after one season's experience it is fair to state that the institution has assumed a strong position in the fruit-growing and fruit-marketing world.

Permanent Organization

At Hood River, Oregon, May 30 and 31, 1913, occurred the final organization and actual affiliation of six sub-centrals, including the Apple Growers' Association of Hood River, Oregon; Yakima Valley Fruit Growers' Association of North Yakima, Washington; Walla Walla Fruit Distributors of Walla Walla, Washington; Idaho-Oregon Fruit Growers Association of Payette, Idaho; Montana Fruit Distributors of Hamilton, Montana, and Spokane Fruit Growers' Company of Spokane, Washington.

The Central Idaho-Washington Fruit Growers' Association of Garfield, Washington, completed affiliation on July 19, 1913, and the Wenatchee-North Central Distributors of Wenatchee, Washington, completed affiliation on July 19, 1913.

Tonnage and Results

From July 8, 1913, to August 30, 1914, the distributors handled a total of 3,958 cars of fruit and 1,125 cars of potatoes,

making a total of 5,083 carloads with a total of 2,989,295 packages, exclusive of potatoes and melons, aggregating a realized price, net to the distributors, of $3,069,953.51, without the loss of a single penny through failure to collect.

Distribution of fruit covered 243 cities in 38 states, 33 cities in six Canadian provinces, and 179 carloads were exported to 16 cities in 10 European countries. Shipments were also made to South America, South Africa, Australia and the Philippines.

The average price realized per box for apples for all varieties of all districts, all grades and all sizes, was $1.26, f. o. b the shipping point.

Of total shipments of 3,958 cars of fruit, 2,102 cars (54 per cent) started on f. o. b. orders, 1,790 cars (45 per cent) were started as tramp cars, but 3,284 cars (83 per cent) were delivered on a f. o. b. basis; 26 cars only were shipped on consignment and only 92 cars (2½ per cent) were finally delivered on consignment. (Leading authorities of the Northwest estimate that heretofore at least 70 per cent of our entire apple tonnage was consigned.) A majority of these, however, were damaged cars or rejections that could not be successfully delivered on the basis shipped, and, to avoid unnecessary sacrifice, were turned over to responsible dealers for sale for our account. Cars sold through auction numbered 299 (7½ per cent).

System of Financing

The system of financing is worthy of consideration. A grower or organization that accepts a loan or advance from a dealer or buyer virtually mortgages his or its tonnage to that buyer and his particular market, and therefore shuts off all other buyers and all other territories from the sale of his fruit. Prices may be far better in other territories and possibly freight rates less, but the fruit must go on to the man who lent the money if the obligation exists. But if (as with the growers with the North Pacific Fruit Distributors) the money is borrowed from the banks—the legitimate institutions to borrow from—all buyers and all territories are opened as a market for the fruit.

During the past season a total of $551,000 was made available for advances to the growers of our respective districts This was in part from funds on hand in local or sub-central reserve funds; in part through bank accommodations arranged with local banks by the sub-centrals, and in part through bank loans arranged for by the central office. And what is most gratifying to note is that over $400,000 additional was voluntarily offered by Spokane banks upon growers' warehouse receipts This, however, there was no occasion to use.

No one fact stands out in bolder contrast with the past than does this tribute paid to the distributors by the conservative bankers of the Northwest when they so completely reversed former practice and either lent or offered to lend nearly one million dollars for advances upon a product so perishable in nature that it had been heretofore regarded by them as an utterly impossible security. It is interesting to note also that of the amount borrowed, every dollar was repaid on or before maturity of the loan and the greater part even before maturity.

By the just and equitable plan of pooling like varieties, grades, etc., of fruit (of each separate district within itself), there has been brought to the industry such stability that fruit products under the distributors' control are considered a safe and acceptable collateral not previously regarded as possible under the most favorable conditions.

Retail Price and Consumption

Never before throughout the Northwest has been maintained anything like a uniform price for a given grade and variety of fruit throughout the several producing districts. Heretofore each district has graded its fruits according to its own notion and maintained its own individual price This encouraged middlemen to speculate on prices and destroyed all possibility for anything like a uniform price to the trade throughout the whole country. The selling methods this year have

operated toward a more common understanding of price conditions and the elimination of bargain hunters to the material advantage of both the retail trade and general consuming public.

Again, never before have the growers of the Northwest themselves had such a source of dependable information with respect to prevailing prices and true market conditions, common knowledge respecting which, from the standpoint of growers, retailers and consumers, has had a decidedly beneficial effect toward increasing consumption.

Sales Policy

With the announcement last August of the sales policy of the distributors there was brought to the Northwestern boxed apple business a stability and orderly control wholly lacking and entirely absent during the speculative years of the past. The announcement that the season's sale would begin upon a price basis sufficiently moderate to attract the dealers' investment early in the season (thereby affording the trade, as prices advanced, due and proper protection upon their investments previously made), met with a quick response and a hearty approval from the trade. They were quick to observe that the growers under that policy would eliminate much of the risk heretofore attending early sales and that the growers who controlled the product in the first instance, instead of the purchaser and speculator, thus became the real regulators of the market. It remained only to adhere strictly to the policy outlined and to demonstrate good intentions and good faith in efforts to maintain a uniform price, coupled with a steadfast refusal to undersell previous quotations, to gain the trade's entire confidence This enabled the organization to book and make advance sales of a substantial portion of the surplus and in a most positive and material degree relieve the accustomed harvest pressure and avoid the usual declining markets at that critical season of the year.

None previously had been sufficiently bold to advocate low or moderate prices at the opening of the season. The very audacity of the proposal was both startling to the growers and a pleasing innovation to the trade. The trade, while acknowledging the decided advantage that would accrue alike to themselves, the growers and consumers, were nevertheless skeptical regarding the ability to reconcile the growers to even a moderately low opening price and successfully maintain such a policy. It is pleasing, indeed, to note, however, that the growers quite generally were most favorably impressed with the force of the proposition; and, with a greater degree of unanimity than would ordinarily be expected, quite loyally supported the plan.

A steady market was maintained until the middle of March, when distributors' holdings were all disposed of and it released its steadying influence. Within a very few days speculators realized that the situation was in their hands and they began cutting prices, and the apple market was soon in a chaotic condition, where it remained until the end of the season, resulting in the loss of thousands of dollars to the storage-apple holders.

Purpose

The purpose of the organization is to get a larger economy in assembling, a wider distribution, a lower price to the consumer and therefore an increased consumption; scientific advertising; and, in short, to put the business on the same basis as any other business stands in order that the grower's business may be managed in a business way and under the control of the grower himself.

Government

The four states of Oregon, Washington, Idaho and Montana are roughly divided geographically (and regardless of state lines) into a number of "Sub-Central Districts"—at present nine—which number may be increased or decreased at any time. Each sub-central district elects one trustee to represent it on the central "Board of Trustees" Each sub-central also elects two members of the "Council of Representatives." In these two bodies rests the general control of the organization.

Board of Trustees

The Board of Trustees, with as many members as there are districts, generally speaking are in control of the central's affairs. Regular monthly meetings are held, unless formally postponed, and special meetings are held from time to time as business demands Each trustee has equal voice and vote in these meetings regardless of the tonnage he represents. The board of trustees determines all policies, elects all officers, determines all salaries, determines all changes, and all increases or decreases in sub-central membership, and has general control of all property and other interests of the company.

Council of Representatives

The Council of Representatives, with twice as many members as there are districts, meets only when called by the trustees on the demand of two trustees or on the demand of eight members of the council itself, and then considers only those special matters which are specified in the call. The voting strength of each member is on a tonnage basis, namely, each member shall be entitled to one vote for each 100 cars or major fraction thereof marketed by his district through the central. Action taken on any matter properly considered by the council is binding on the board of trustees and all officers of the corporation.

Modus Operandi

The North Pacific Fruit Distributors is a large assembling, distributing and selling agency. In the orchards of Oregon, Washington, Idaho and Montana, its machinery is the 6,000 growers, 94 local associations, and its nine sub-centrals. In the markets its machinery is its central, branch and district offices, and its more than 100 exclusive agency connections through which it covers every portion of the civilized world. Through its Northwest growers, locals and sub-centrals it makes a survey of the crop situation, gathers the information of available tonnage of its various districts as to variety, grade and sizes, tabulates this data in its stock book at the central office, each week checking in order to keep a correct up-to-date record of the stock available. From its salaried representatives it gathers a knowledge of the crop and market conditions throughout the entire world, and this information through many thousand telegraphic and telephonic reports keeps the central office thoroughly informed on matters concerning the world's markets.

From this world-wide machinery the central receives orders for fruit, which orders it transmits through the sub-central and local organizations to the grower. These growers and locals assemble and load their fruit, assemble the necessary manifests and other data, and this data through locals and sub-centrals by telephone and telegraph finds its way to the central. Many hundred copies of a bulletin or "tramp sheet," plus many personal telegrams transmits daily the knowledge and data of this fruit available to the exclusive agency connections and to possible customers in the markets of the world. Back from these world's agencies come the orders for fruit, some to be loaded to order and others for fruit already loaded. These orders are then transmitted through the sub-centrals and locals. From the agency connections of the markets of the world comes the money for the cars sold. All this via the central, reaches the growers through the sub-central and local associations.

From the growers, locals and sub-centrals, come the reports of the condition and nature of the fruit when loaded. And as the cars pass through the cities where the agents are established, and likewise when they reach their destination, back to the central from the world agencies come similar reports of inspection with condition of fruit, and the central again is in position to collect the necessary damages, make necessary allowances and otherwise intelligently handle the situation.

METHODS EMPLOYED BY A FRUIT-MARKETING AGENCY

There are approximately 10,000 dealers in fruits and vegetables in carload lots in the United States and Canada, not to mention those in foreign countries. Under the most favorable conditions it is

doubtful if more than 2 per cent have ever been represented in person in any one season at Northwestern shipping points. Under less favorable conditions the percentage drops to a minor fraction of 1 per cent. It is on this minority factor that the individual fruit grower or shipper unaffiliated with any organized sales agency depends for his market, while he loses sight of the fact that 98 per cent or more of the total buying power is lost to him.

While the cash demand f. o. b. in any comprehensive scheme of marketing is an important and not-to-be-disregarded part of the whole, it is equally true that any system which does not provide means for reaching the 98 per cent or more of the trade who are the stay-at-homes or absent buyers is fatally weak and wholly inadequate to meet industrial needs of a business which is inherently competitive.

It is axiomatic that true value is the pivot on which supply and demand balance. In order to secure maximum value 100 per cent of the demand must be employed; also, where the supply is increasing from year to year, new demand must be created at least to keep pace with the additional supply if decline in values would be prevented. If only 2 per cent or less of the demand is employed there will be many times when it will be found far inadequate to absorb the supply at prices profitable to the producer.

Having seen then that the absent buying class forms by far the most important section of the market, it will be interesting to note some of the machinery and some of the many operations in the process of a complete transaction between the merchant, i. e., the Northwestern producer, and his customer, i. e., the buyer in a distant market.

When it is remembered that in the case of Northwestern fruits the producer is distant about 2,500 miles from the average of his markets, the difficulties and complications of the business can be guessed, and will hereafter be illustrated. For purposes of demonstration a typical transaction has been selected, all documents photographed and reproduced as under:


Portland Oreg.

Figure 1

S., a fruit grower of the Wenatchee valley, has a carload of Rome Beauties to sell. He makes a manifest of the lot, and mails it to his sales agency.

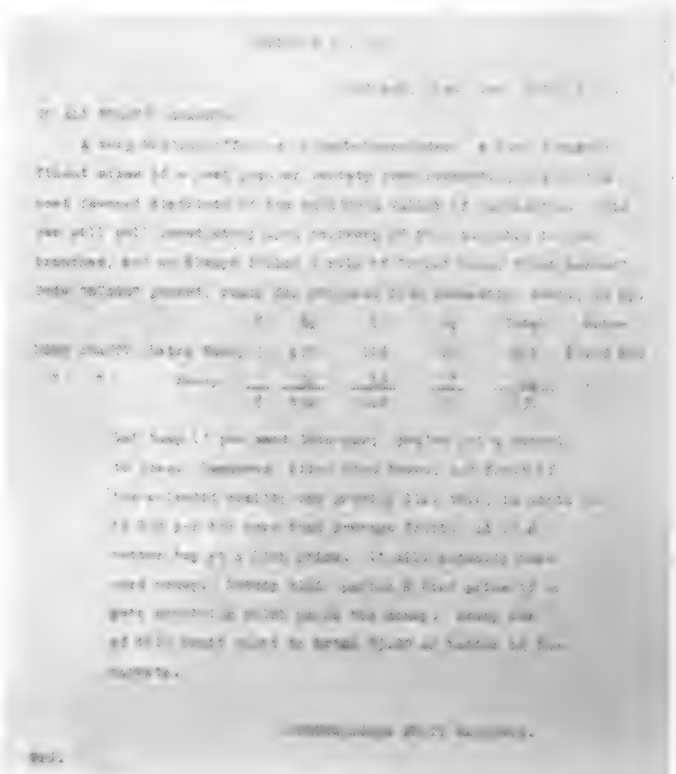


Figure 2

Bearing in mind that maximum value depends on the employment of maximum demand, the idea is now to offer this car to the whole trade, i. e., to everyone of

the 10,000 or so dealers, and to do it practically simultaneously. This is possible under modern conditions only by means of a resident sales organization.

The country is divided into zones, and a resident salesman established at the most important distributing center in each. The aim is to restrict the size of each of these zones to the extent of the salesman's ability to cover all of the trade therein daily, either in person or by telephone. There are 103 district agencies in this country and Canada and three foreign agencies, in the case of the particular sales agency in illustration. Upon receipt of the manifest from S., the sales department issues a bulletin reproducing the manifest in detail, and further describing the offering, where and by whom grown, and price wanted. It is interesting to note that in this case the producer has set a price on the merchandise which is less than its worth, and one of the first items of service on the part of his agency is to set the correct value on the fruit, in this one action saving the producer several times the amount of the fee for the entire service. It is of course well known that the producer is rarely in position to estimate the correct value of his merchandise, as he has not the detailed information on which to base a valuable judgment. A bulletin is mailed to the entire list of district sales offices, and by this means the entire buying power of the whole market is concentrated on the offering. This means that the maximum demand is being employed to insure the desired maximum value.

Figure 3

Five days after the issue of the bulletin the first results are seen in the shape of a telegram from Cincinnati branch; the salesman having canvassed his market, one dealer was willing to buy the car at a price 50 cents per box less than the price asked. In declining this offer a counter-offer is made, subject to confirmation, in order to test the strength of the position. The sales manager making this move knows that in a few hours more there will be received from other sections of the country in-

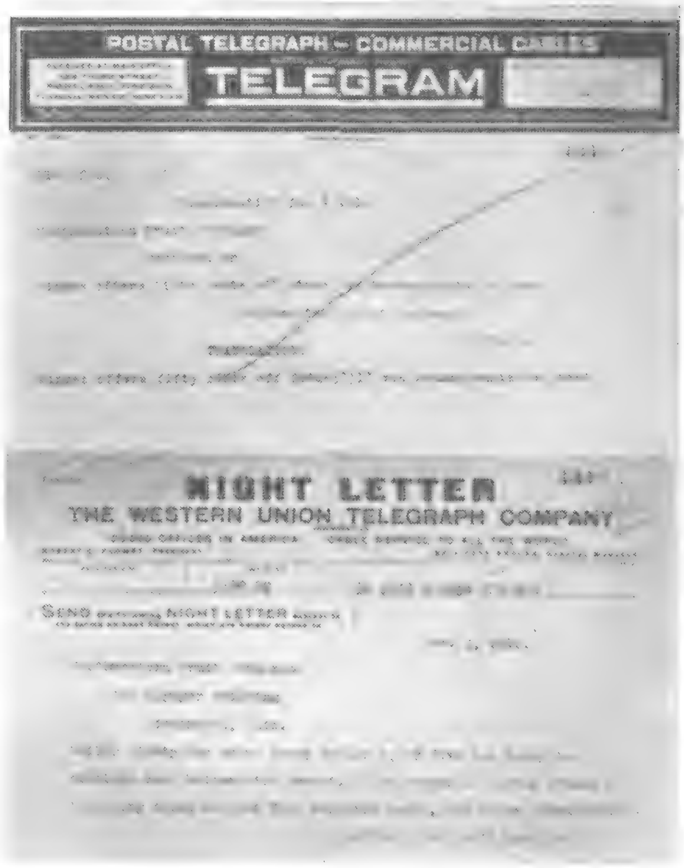


Fig. 3.

quiries or offers for this lot, if the demand exists anywhere.

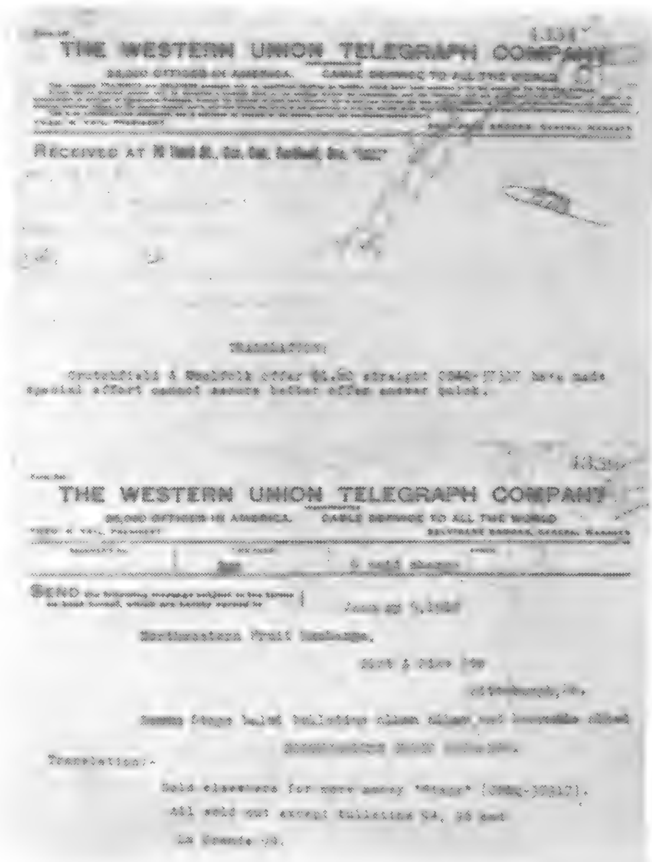
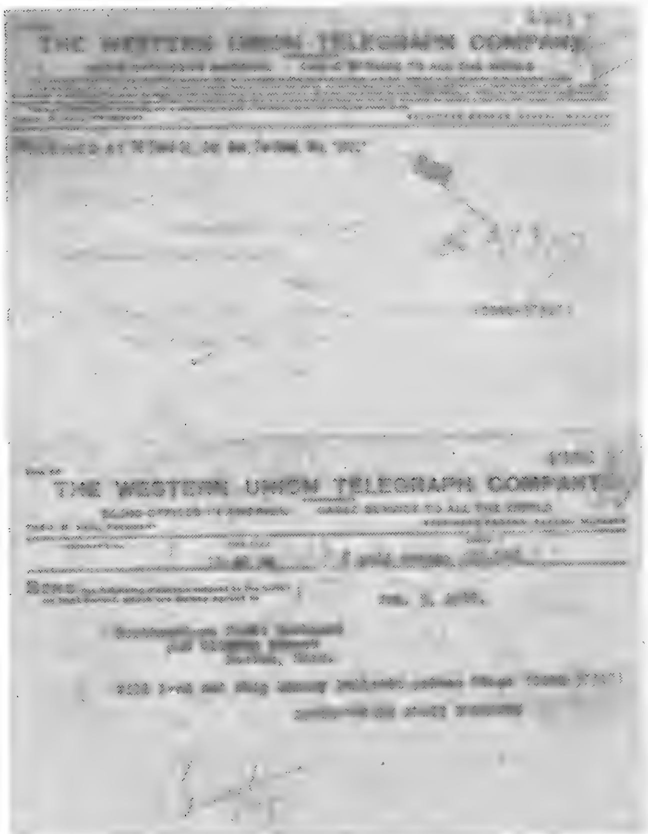


Fig. 4.

Figures 4 and 5

The next morning two other branches are heard from: Pittsburgh, which offers


THE WESTERN UNION TELEGRAPH COMPANY

THE WESTERN UNION TELEGRAPH COMPANY

Fig. 5.

a somewhat better price than Cincinnati, and Boston, which submits an order from a well-known dealer at full asked price, whereupon the Pittsburgh offer is declined and the Boston order confirmed, and the first stage of the transaction has been completed. This is a perfect illustration of the system. Cincinnati, by means of the salesmanship of the resident representative, was made to offer all that the condition of the market there warranted. Pittsburgh was in somewhat better shape, but the one market that could afford to buy and use this car at the extreme value was Boston, and by the operation of the system this important fact was discovered and capitalized.

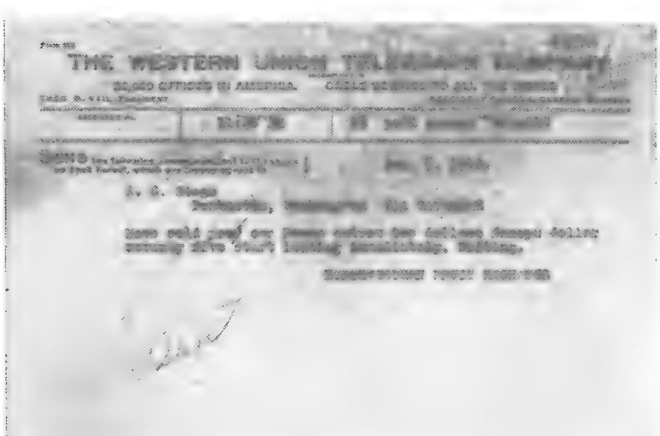

THE WESTERN UNION TELEGRAPH COMPANY

Fig. 6.

Figure 6

Here the grower is notified of the sale, and instructed to begin loading, pending receipt of detailed instructions by mail. Under the old crude methods, the confirmation of sale would have been regarded as about the closing step in the transaction, whereas, under the comprehensive system nowadays employed, the process of turning the fruit into money has therewith only begun, and will not be complete until the delivery is safely made and the money actually paid over. The "usual terms" in the fruit trade being "inspection and acceptance at destination," the producer is practically obligated to assume the risks of sound and satisfactory delivery to the buyer; hence, modern marketing service contemplates not merely the negotiation of the sale but the safeguarding of the producers' interests against all the hazards of transportation to a distant market. In the perishable-fruit trade a multitude of things can happen to a shipment between the time of its sale f. o. b. and delivery to the buyer. Hence, the latter part of the service, while less spectacular than the negotiation of the sale itself, is nevertheless equally important or even more so. It is likewise the most expensive part of the service.

Figure 7

One of the greatest disadvantages of the fruit business is the matter of rejections by the buyer. It is human nature to blame the other fellow, but experience shows that the seeds for most rejections are sown by the seller himself at the time of negotiating the sale. Frequently the fruit is overdescribed by a too enthusiastic salesman, and the buyer given grounds for justifiable rejection on the basis of misrepresentation. The temptation to do this is so great that strictly first-class fruit salesmen are harder to find than salesmen in almost any other business. Also, the fruit trade has been developed very rapidly, and has far outstripped the methods for its conduct. It has been customary to do the business entirely on verbal understandings, whereas, in other fields of merchandising, sales

Fig. 7.

are usually confirmed in writing. Modern sales agencies in the fruit trade are endeavoring to correct this defect, and in this illustration is shown the quadruplicate order form which is executed as soon as the sale has been confirmed by telegraph. In these are set down each and every verbal understanding of whatever nature. The grading rules under which the fruit is to be packed and shipped are indicated, and every possible precaution is taken to remove all possibility of misunderstanding, and therefore of justifiable rejection. The original of this form is filed by the sales agency and a duplicate mailed to the shipper for his guidance in making the shipment. There is a coupon on his copy for him to date and sign and mail back to the sales agency, which forms a written acceptance and confirmation of the sale for his account. The triplicate is mailed to the buyer and the quadruplicate to the district sales office at point of destination. Thus, in one operation, all four parties to the transaction are notified in identical language, and any exceptions may be noted and filed in time to permit correction and avoid dispute. While this system does not entirely do away with rejections, it to a very important extent minimizes them.

Figure 8

Letter from sales department to grower, transmitting the order, and giving certain instructions. The time being midwinter, with cold weather prevailing along the route, extra precautions must be taken to prevent the fruit from being frozen in transit. At this juncture the sales department has completed its service for the time being and the transaction is taken up by the traffic department—an indispensable adjunct to any successful marketing system. This department, as all others, is manned by experts in their line.

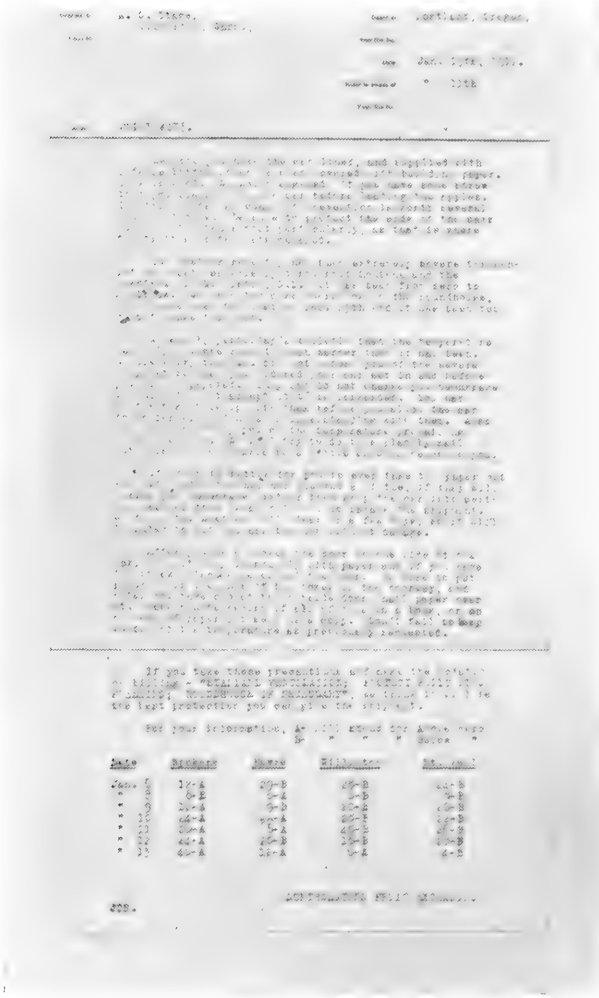
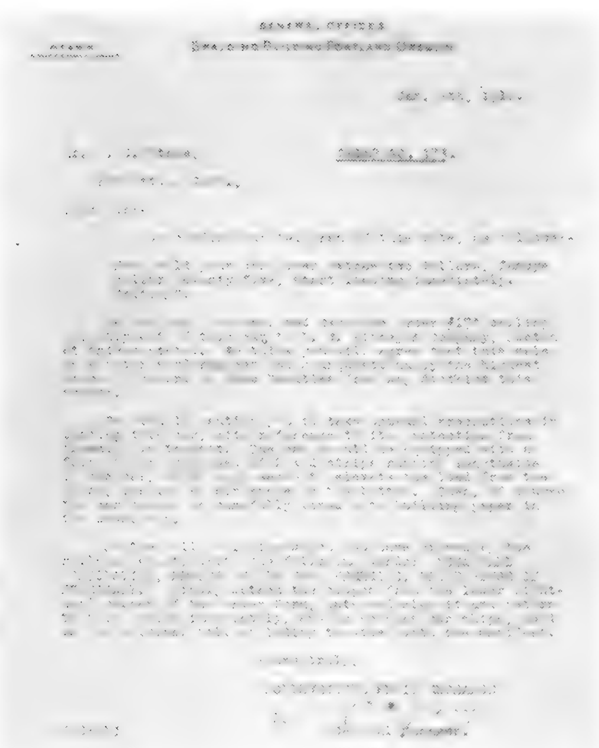


Fig. 8.

Figure 10

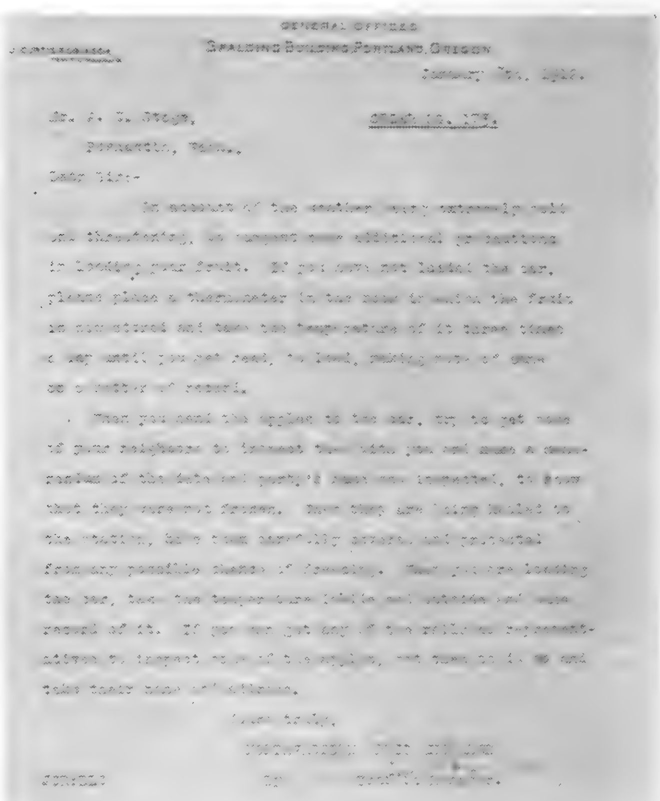
Cold weather in the Rockies threatens to delay the shipment.



GENERAL OFFICES
SPALDING BUILDING PORTLAND, OREGON

Figure 9

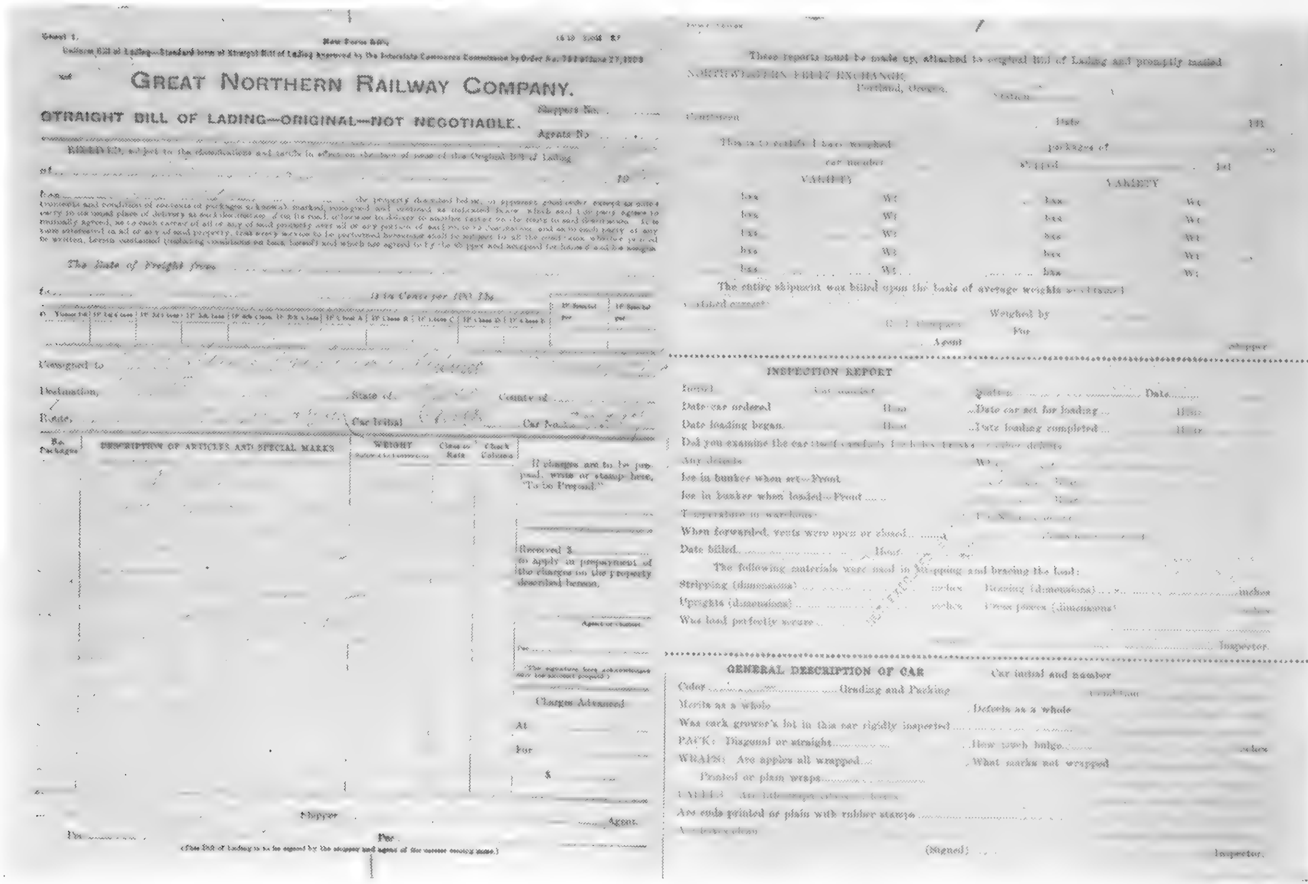
The traffic department instructs the grower in the steps to be taken in the protection of his interests.



GENERAL OFFICES
SPALDING BUILDING PORTLAND, OREGON

Figure 11

Further instructions by traffic department to grower, showing very low temperatures prevailing along the route over


GREAT NORTHERN RAILWAY COMPANY.

STRAIGHT BILL OF LADING—ORIGINAL—NOT NEGOTIABLE.

INSPECTION REPORT

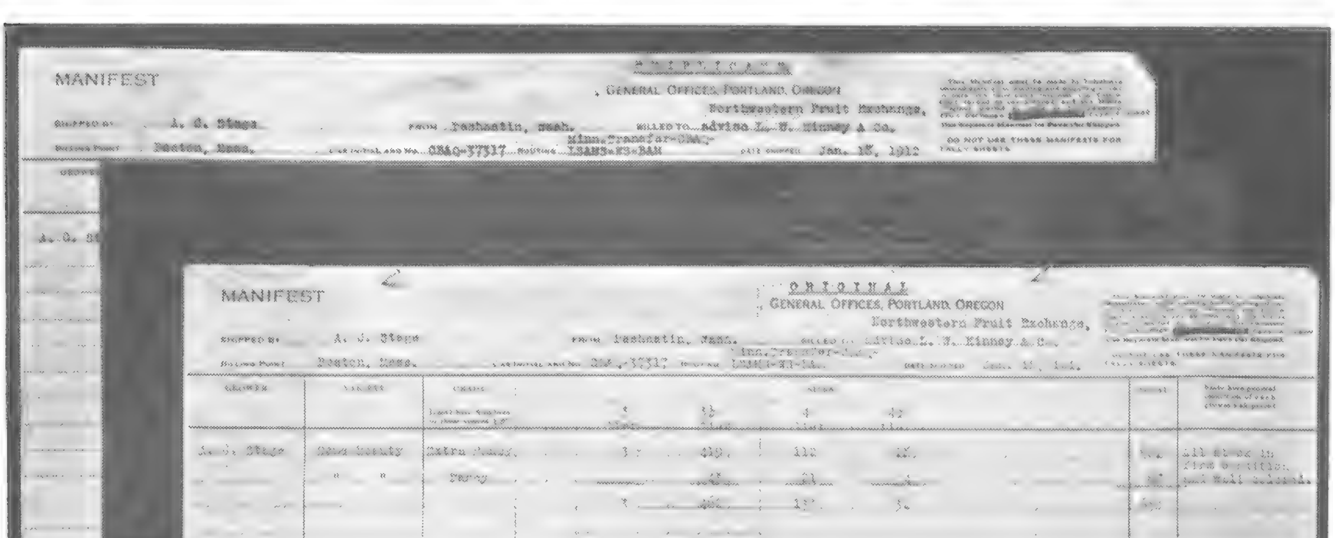
GENERAL DESCRIPTION OF CAR

Fig. 12.

which car must pass, thereby emphasizing the importance of the proper preparation of the shipment to protect it from freezing.

Figure 12

In the left of the picture, original railroad bill of lading, showing the proper notations. On the right, the three inspection forms required by the sales agency to be made out by the grower. The top section is a weight report, to avoid freight overcharge by the carrier. The middle section is an inspection report of the railway equipment offered by the railroad for transportation of the fruit. It is very important that only equipment in good order be accepted, and loaded; doors tightly fitting, and drain pipes, plugs, vents, etc., all in good working order. Otherwise, damage may result and claim difficult or impossible to collect, owing to technicalities in the transportation laws. Finally, the bottom section is used to record the quality, grade, condition and pack of the fruit as well as of the boxes in which it is packed.


MANIFEST

GENERAL OFFICES, PORTLAND, OREGON

MANIFEST

ORIGINAL

GENERAL OFFICES, PORTLAND, OREGON

Northwestern Fruit Exchange,

Fig. 13.

Figure 13

Manifest in triplicate, accompanying the bill of lading to the head offices. With the mailing of these documents, properly executed, the growers' work and responsibility cease, assuming the fruit has been properly grown, graded and packed, and loaded into the car.

Figure 14

Showing the front and back of the card containing the full sales record of the car. When the sales department completes the sale, the card is turned over, the details of the sale written in, and the card passed to the accounting department, which then becomes responsible for the collection of the invoice from the buyer, and the issuing of a proper accounting to the owner.

Figure 15

As soon as the bill of lading is received a card is made out and on it is carried the traffic record of the car from the time it leaves shipping point until its safe arrival and delivery to the buyer. The routing of the car is first laid down, then a list of principal divisions or passing points is written in. Freight-train schedules are consulted, and the dates are filled in on which the car should pass each point if on schedule time. In the parallel column are filled in the dates on which the car actually passes those points, this information being furnished by the railroads themselves by telegraph. This railway record serves a number of very useful and important purposes. Should the car fall behind time the traffic depart-

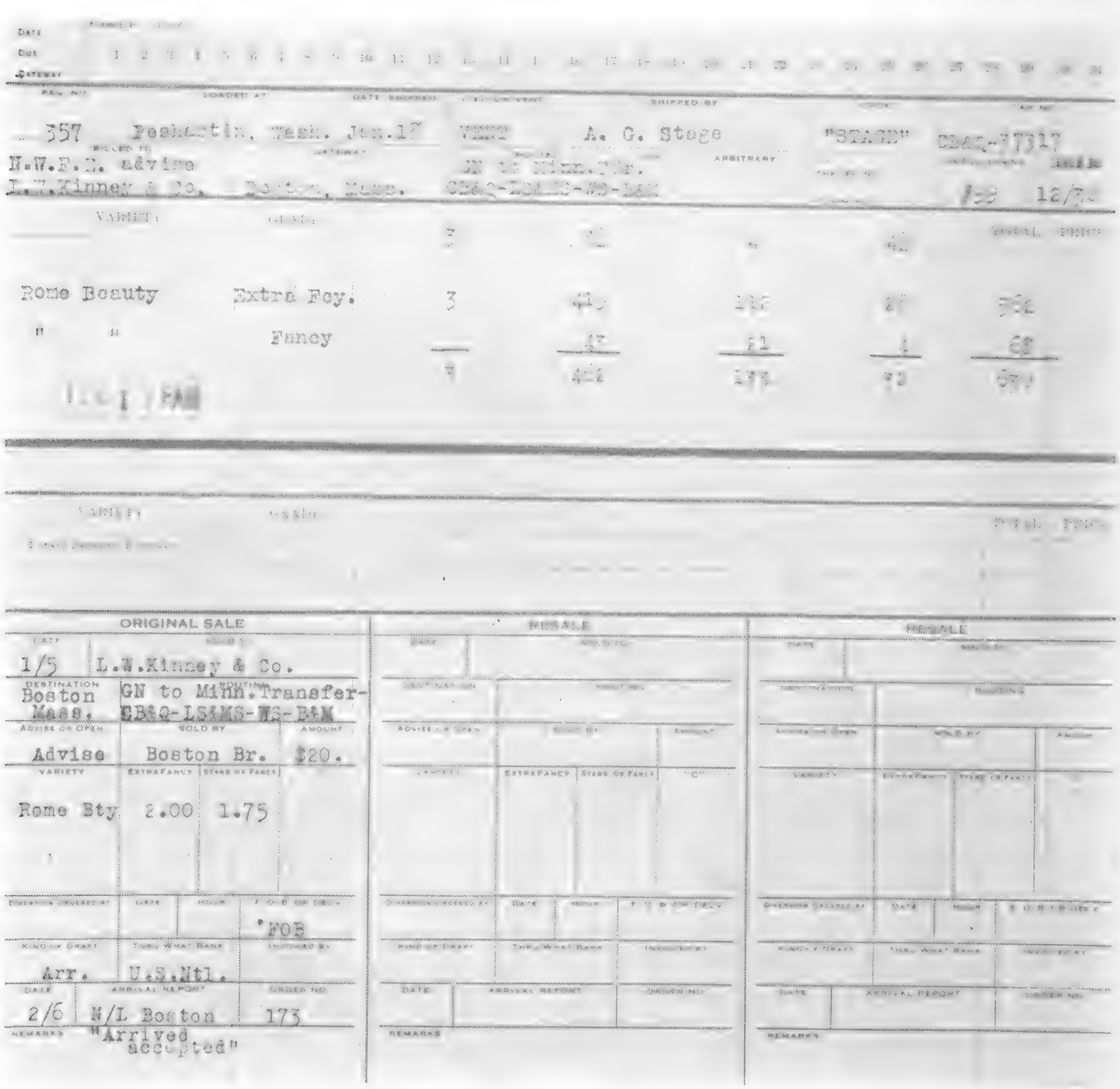
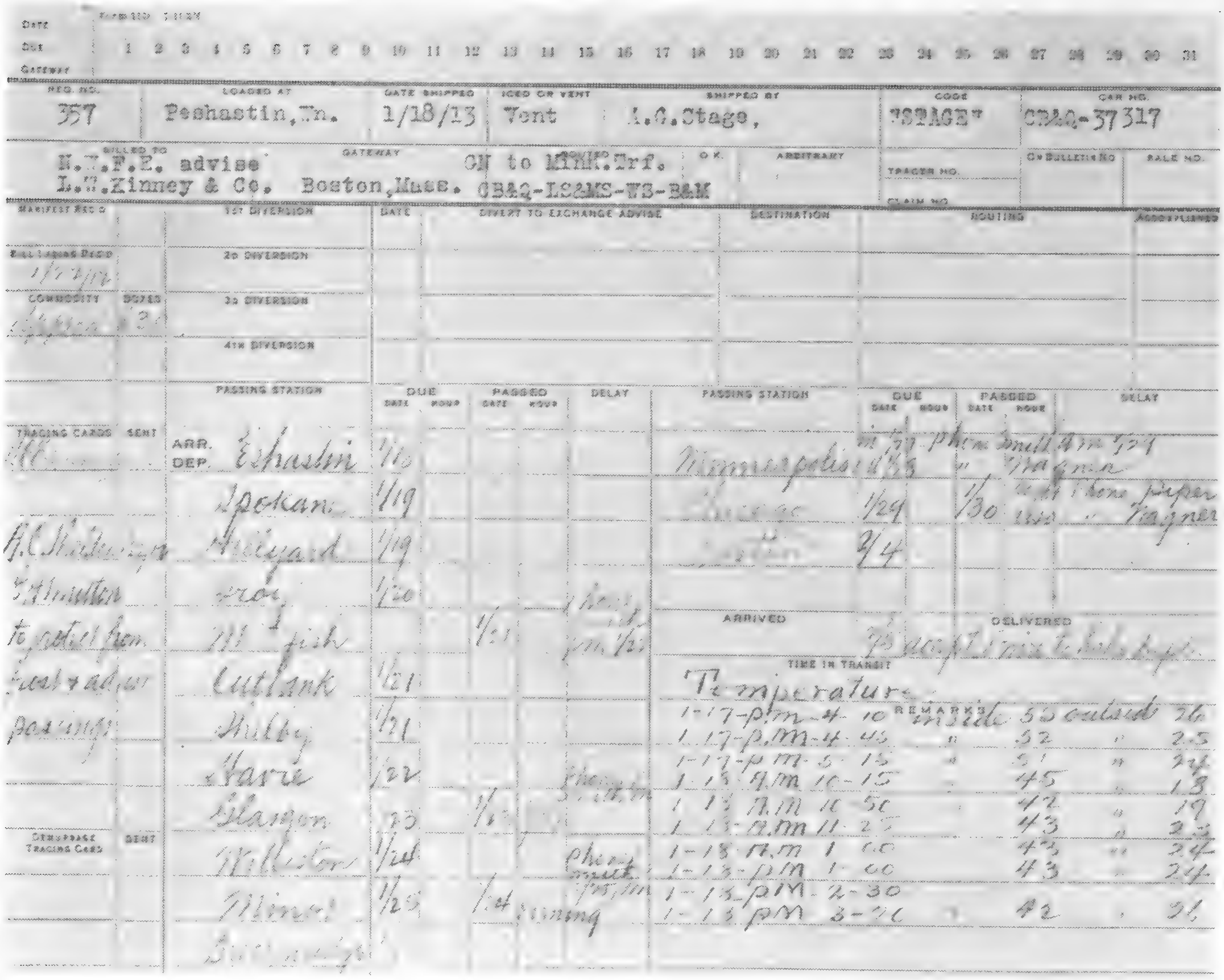


Fig. 14.


DATE
OUT 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
GATEWAY

REG. NO.	LOADED AT	DATE SHIPPED	ICED OR VENT	SHIPPED BY	CODE	CAR NO.
357	Peshastin, Wn.	1/18/13	Vent	A. G. Stage,	"STAGE"	CB&Q-37317

BILLED TO: N. W. F. E. advise L. W. Kinney & Co. Boston, Mass.
ROUTED: GN to Minn. Trf. CB&Q-LS&MS-WS-B&M

MANIFEST REC'D — 1ST DIVERSION — DATE — DIVERT TO EXCHANGE ADVISE — DESTINATION — ROUTING — ACCOMPLISHED
BILL LADING REC'D — 2D DIVERSION
COMMODITY — BOXES — 3D DIVERSION
4TH DIVERSION

PASSING STATION	DUE	PASSED	DELAY
ARR. DEP. Peshastin	1/18		
Spokane	1/19		
Hillyard	1/19		
Troy	1/20		
Cutbank	1/21		
Shelby	1/21		
Havre	1/22		
Glasgow	1/23		
Williston	1/24		
Minot	1/25	1/24	running

PASSING STATION	DUE	PASSED	DELAY
Minneapolis	1/25		
Chicago	1/29	1/30	
Boston	2/4		

ARRIVED — DELIVERED

TIME IN TRANSIT

Temperature

REMARKS

1-17-p.m.-4-10	inside	35	outside	26
1-17-p.m.-4-45	"	32	"	25
1-17-p.m.-5-15	"	51	"	24
1-18 a.m. 10-15	"	45	"	18
1-18 a.m. 11-50	"	42	"	19
1-18 a.m. 11-25	"	43	"	23
1-18 p.m. 1-00	"	43	"	24
1-18 p.m. 1-00	"	43	"	24
1-18 p.m. 2-30				
1-18 p.m. 3-20	"	42	"	21

TRACING CARDS SENT
DEMURRAGE TRACING CARD SENT

Fig. 17.

ment warns the carrier and ofttimes prevents loss and a claim, or, if warning does not suffice and the car is delayed or damaged, the record ofttimes enables claims successfully to be prosecuted that might otherwise be declined for lack of substantiation. Government weather maps, received daily, are checked up and temperatures at various points entered on traffic cards, as shown in the illustration.

Figure 16

On the left, invoice in triplicate; original to the buyer, duplicate to district sales office, triplicate on post binder, forming automatic charge record. On the right, (a) draft in triplicate; (b) delivery order; (c) inspection permit. The draft is drawn on the buyer for the amount of the invoice, payable on arrival of the car. Attached to the draft is the delivery order, without which the buyer cannot get possession of the car, which is billed to the sales agency itself with instructions to notify the buyer on arrival. With the invoice sent by mail direct to the buyer is enclosed the inspection permit, so when the car arrives the buyer is notified by the railroad, presents his inspection permit, examines the shipment, and if as represented and in good order goes to the bank, pays the draft, detaches delivery order, presents it to the railway company, and takes possession of the car. In order to keep close tab on the collections the accounting department writes the draft in triplicate; the duplicate going on a post binder in numerical order, and the triplicate is used as a "tickler card." The traffic department having already figured out the date on which car should arrive, the accounting department allows a reasonable time for the clearance of the funds, and sets a date on which they should be reported by local bank, and the "tickler card" is set under that date. When it rolls around, if draft is not reported paid, a tracer is started.


NORTHWESTERN FRUIT EXCHANGE

L. T. Kinney & Company,
Boston, Mass.

NORTHWESTERN FRUIT EXCHANGE

THE UNITED STATES NATIONAL BANK

NORTHWESTERN FRUIT EXCHANGE
PORTLAND, OREGON

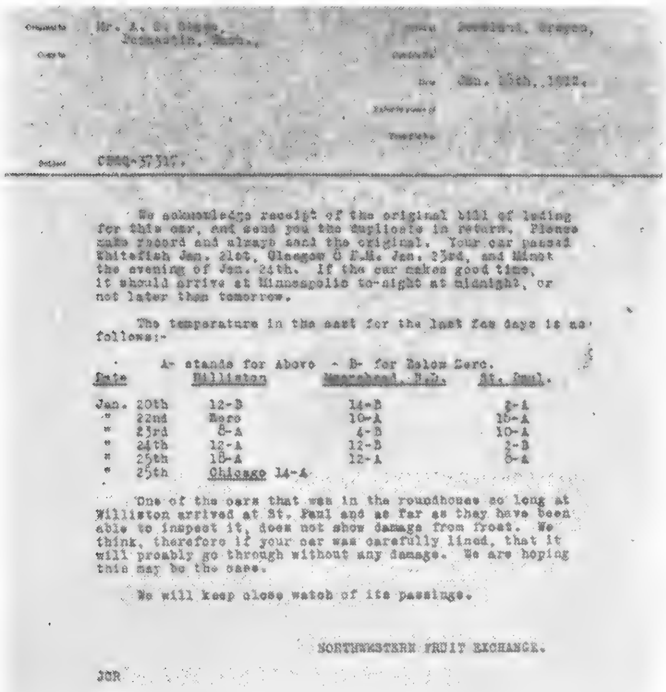
THE UNITED STATES NATIONAL BANK

NORTHWESTERN FRUIT EXCHANGE

Fig. 16.

Figures 17, 18 and 19

All show steps in the checking and tracing of the car by the traffic department.


Mr. A. C. Gibson,
Pehastin, Wash.

Portland, Oregon,

Jan. 25th, 1912.

CB&Q-37317.

We acknowledge receipt of the original bill of lading for this car, and send you the duplicate in return. Please make record and always send the original. Your car passed Whitefish Jan. 21st, Glasgow G.N.R. Jan. 23rd, and Minot the evening of Jan. 24th. If the car makes good time, it should arrive at Minneapolis to-night at midnight, or not later than tomorrow.

The temperature in the east for the last few days is as follows:-

A- stands for Above - B- for Below Zero.

Date		Williston	Moorhead, N.D.	St. Paul.
Jan.	20th	12-B	14-B	2-A
"	22nd	Zero	10-A	16-A
"	23rd	8-A	4-B	10-A
"	24th	12-A	12-B	2-B
"	25th	18-A	12-A	8-A
"	25th	Chicago 14-A		

One of the cars that was in the roundhouse so long at Williston arrived at St. Paul and as far as they have been able to inspect it, does not show damage from frost. We think, therefore if your car was carefully lined, that it will proably go through without any damage. We are hoping this may be the case.

We will keep close watch of its passinge.

NORTHWESTERN FRUIT EXCHANGE.

JGR

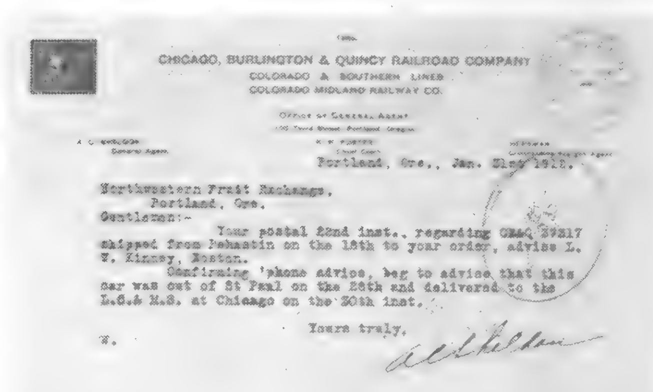
Fig. 17.

Figure 20

Showing the telegram received by the sales department from its Boston branch, reporting the safe arrival and acceptance of the car by the purchaser, whereupon the notice shown at the bottom is issued to the owner. Nothing now remains but the receipt of the money by the accounting department, and its payment to the grower less the marketing fee.

Figure 21

On February 12 local bank reports credit of proceeds of draft, whereupon account of sales is issued to the owner, showing the entire financial transaction in detail. The amount of money reported by the bank must, of course, correspond to the gross amount shown in the accounting, and by means of this and other checks and balances it is very easy for the transaction to be audited and traced from its inception to its conclusion.


CHICAGO, BURLINGTON & QUINCY RAILROAD COMPANY
COLORADO & SOUTHERN LINES
COLORADO MIDLAND RAILWAY CO.

Office of General Agent

Portland, Ore., Jan. 31st 1912.

Northwestern Fruit Exchange,
Portland, Ore.
Gentlemen:-

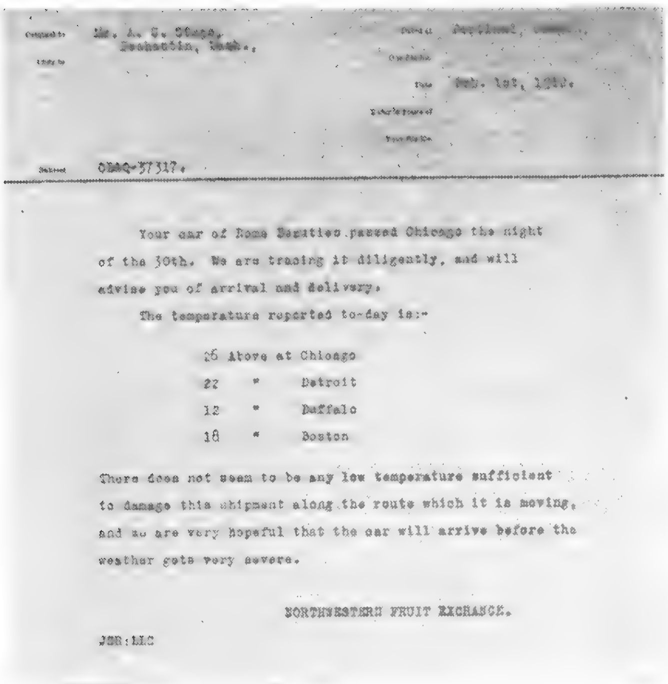
Your postal 22nd inst., regarding CB&Q 37317 shipped from Pehastin on the 18th to your order, advise L. T. Kinney, Boston.

Confirming 'phone advice, beg to advise that this car was out of St Paul on the 28th and delivered to the L.S.& M.S. at Chicago on the 30th inst.

Yours truly,

W.

Fig. 18.



Mr. A. S. Stage,

OBAQ-37317.

Your car of Rome Beauties passed Chicago the night of the 30th. We are tracing it diligently, and will advise you of arrival and delivery.

The temperature reported to-day is:-

26	Above	at Chicago
22	"	Detroit
12	"	Buffalo
18	"	Boston

There does not seem to be any low temperature sufficient to damage this shipment along the route which it is moving, and so are very hopeful that the car will arrive before the weather gets very severe.

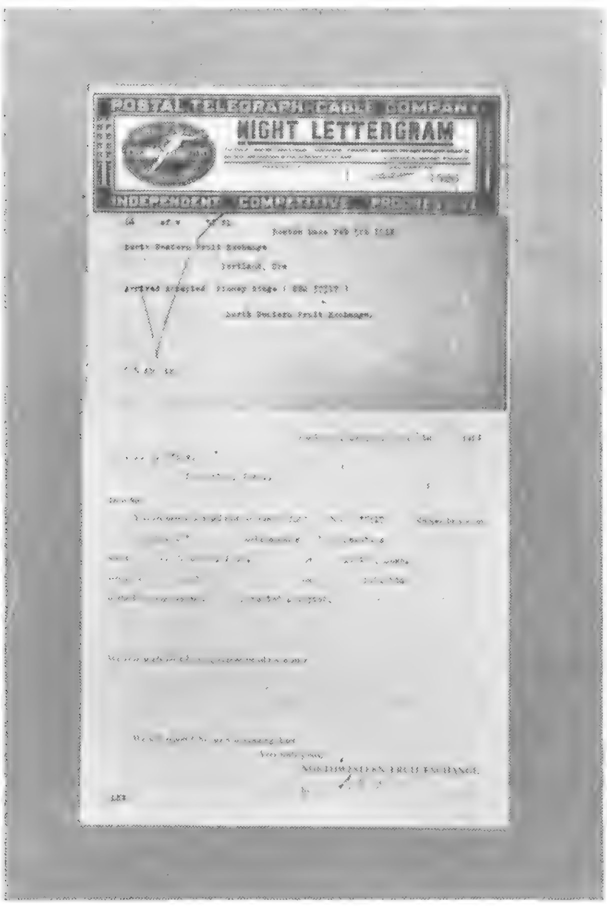
NORTHWESTERN FRUIT EXCHANGE.

JSB:LLC

Fig. 19.

Figure 22

The modern voucher system of accounting is used. This illustration shows the face, inside and endorsed back of the voucher employed in payment of this transaction.



POSTAL TELEGRAPH-CABLE COMPANY

NIGHT LETTERGRAM

Fig. 20.

Figure 23

Arrival and inspection report issued by destination branch. With the receipt and filing of this document, the transaction is complete.

The foregoing shows the necessary steps in a normal transaction. When accident of any kind befalls, and the fruit business is full of accidents, the operations are increased and complicated many fold. In making sales the aim is always to avoid what are called "pocket markets," that is, markets at some terminal from whence cars cannot be diverted, on the through rate of freight. There are very few such markets, if the freight is expertly routed in the first place, and this is another fine point taken advantage of by the traffic department in the growers' interest.

Should cars be rejected, several alternatives offer: either an adjustment can be negotiated with the original purchaser, should he be disposed to be reasonable, or, if the circumstances warrant, the car can be resold to some other buyer and diverted on the through rate. In such a case, practically the entire transaction is duplicated. Cases have been known where the same car has been sold five or six times to as many different buyers. In spite of all precautions there is a certain percentage of losses on account of defective service by the transportation companies, and such losses must be recovered by means of claims. The successful prosecution of railway claims is a fine art. Success depends largely upon the proper fortification of the claim at the time of its inception, and this is possible only under organized methods of sale and traffic. One prominent sales agency in the Northwest, whose methods are here illustrated, has collected in loss and damage claims for the benefit of its members during the past four seasons about $35,000. Under the old individual system of marketing most of this money was either lost by the growers through default or in some cases claims were collected and retained by the consignees as their legitimate perquisite.

The genius of the traffic service, however. lies not so much in the collection of claims as in the prevention of claims. It is much better to deliver fruit to the market in prime condition than to dam-

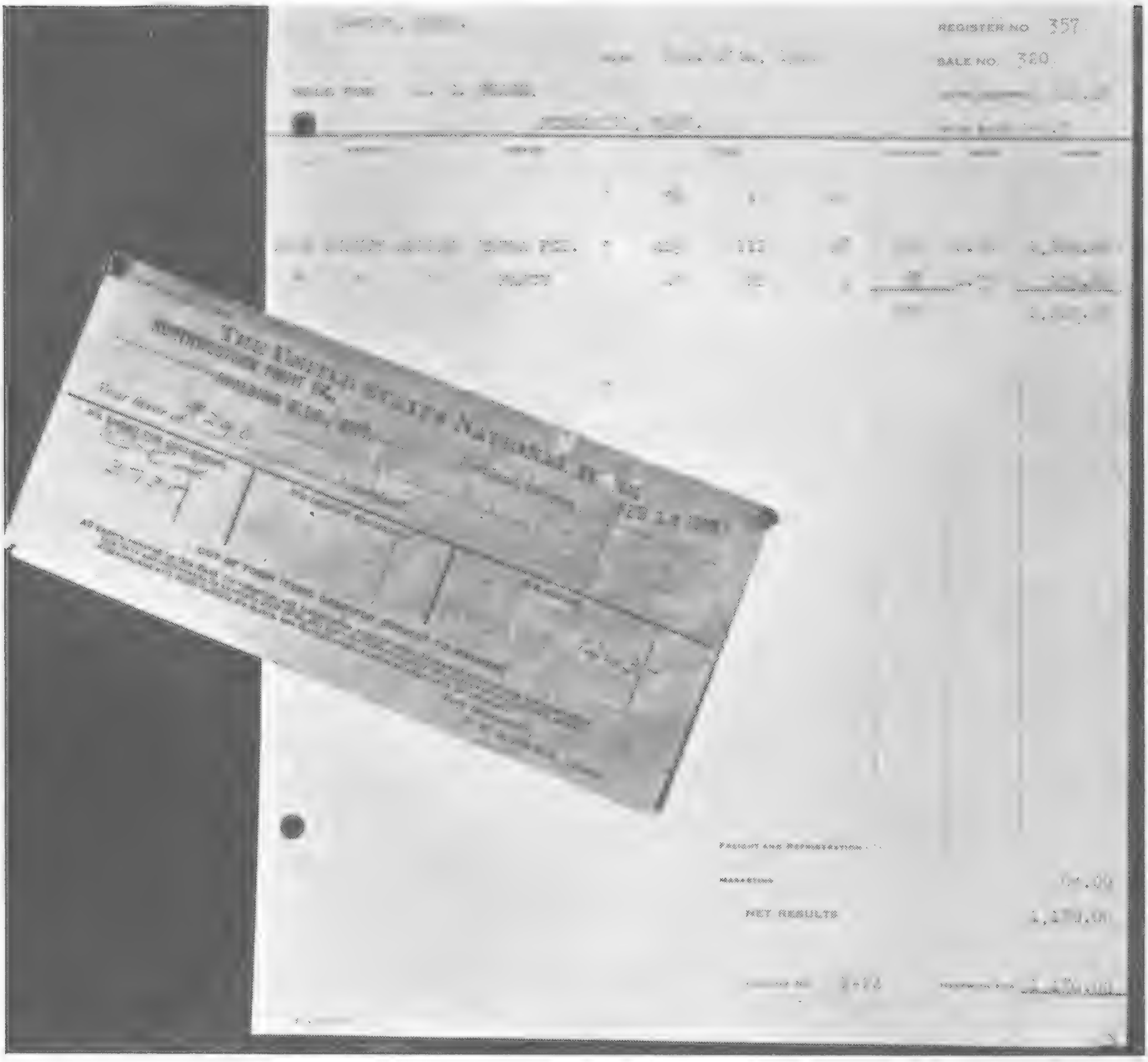
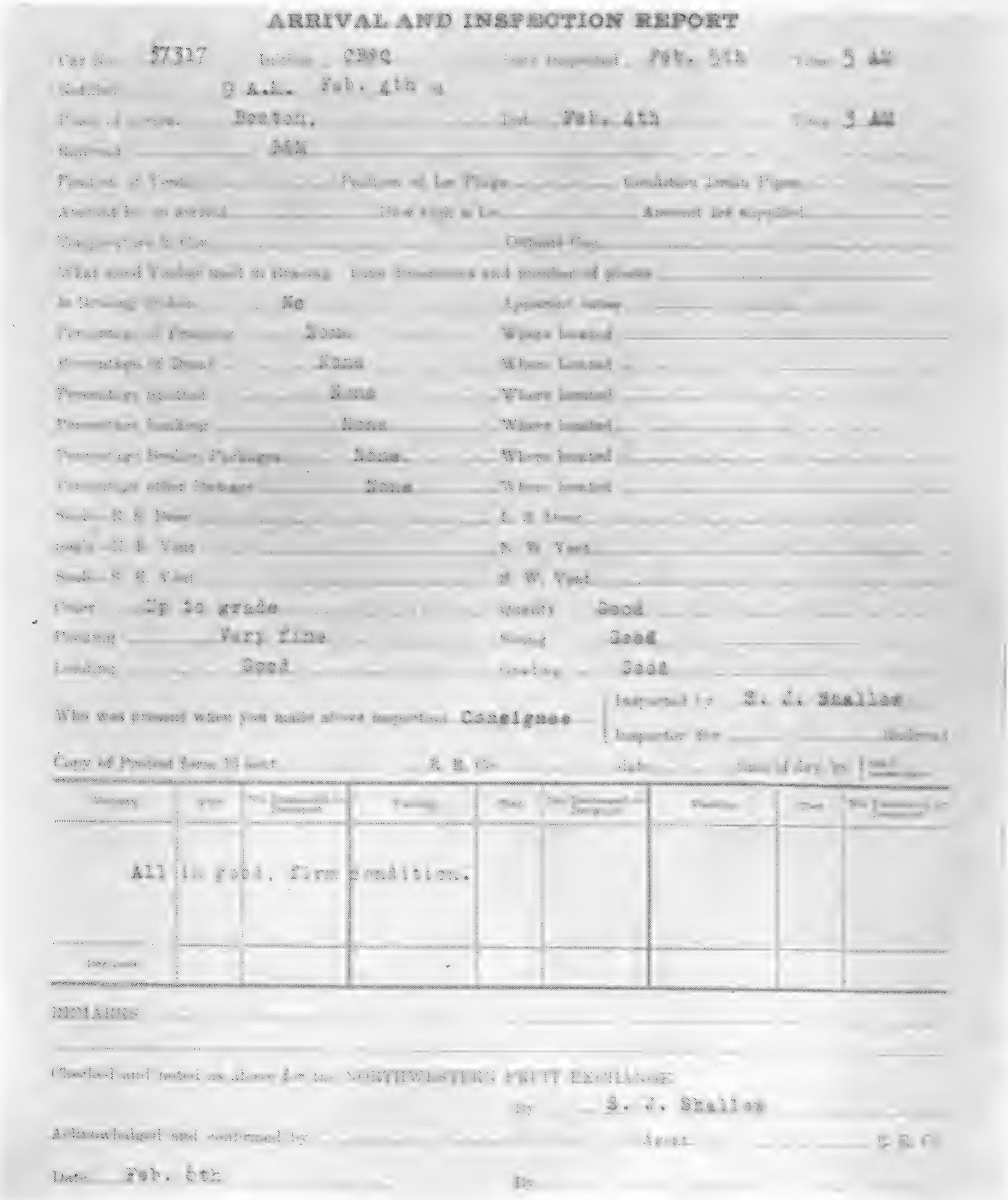


Fig. 21.

age the market by forcing upon it damaged fruit, even though the loss is recovered from the carrier. The organization of the fruit industry of the Northwest has just begun. Much remains. Only through thorough education of the fruit growers as to the importance of every single step in the preparation of their product for sale to the absent buyer and transportation to markets thousands of miles distant, and their close cooperation with their sales agencies, will the production and sale of Pacific Northwest fruit be brought to the point where it may be said to be a science.

W. F. Gwin

Fig. 22.



ARRIVAL AND INSPECTION REPORT

37317 CB&Q Feb. 5th 5 AM

9 A.M. Feb. 4th

Boston, Feb. 4th 5 AM

No

None Where located

None Where located

None Where located

None Where located

None Where located

None Where located

N. W. Vent

S. W. Vent

Up to grade Good

Very fine Good

Good Good

Inspected by S. J. Shallow

Consignee

All in good, firm condition.

REMARKS

Checked and noted as above for the NORTHWESTERN FRUIT EXCHANGE

By S. J. Shallow

Agent

Date Feb. 5th By

Fig. 23.

ECONOMICS OF FRUIT MERCHANDISING

It is characteristic of the weak and derelict to charge their failures to outside influences. Let not those upon whose strength and sanity the welfare of an industry depends, and who, in turn, depend upon that industry, make this mistake. The fact is that most of the "ills that flesh is heir to" are from within, not without. This is an axiom of human activities as well as human life. On this hypothesis nearly all of our own particular economic ills can be attributed to our sins of omission and commission, and the few remaining ones, justly chargeable to the other fellow, can be corrected without the costly necessity of eleminating him.

Speculative Land Values

In the first place, there has been almost from the beginning, both within and without our ranks, reckless promotion of the industry, and "Bull" speculation in its

securities (land values) until there has come the inevitable period of reaction and readjustment, and the "morning after" headache which follows a speculative debauch.

Up to this time, it may conservatively be said that our investments have mainly a speculative value; we are right now at the period of our development when these values must be shown to be intrinsic or else readjusted downward. Their conversion from speculative to intrinsic character depends upon our ability to demonstrate a sustained average earning power for a period of three to five years, in correct proportion to the investment. In the most favored districts, scientific management, applied to every phase of the business from nursery stock to consumer, is the only thing which can accomplish this. In the less favored districts, where production is less generous and regular, where overhead charges are necessarily higher, readjustment of values seems inevitable, and in some cases reversion of the land to more suitable crops.

Too Many and Inferior Varieties

Attendant upon this first evil, followed closely a second and almost equally detrimental one, namely, the extensive planting of inferior varieties. These plantings are now for the most part in bearing, and the product is going into the markets in violation of every economic law, and at the peril of our cherished reputation. For, it must be remembered, this reputation was originally founded on strictly high-class varieties, and eternal vigilance is the price of its maintenance. Some idea of the extent to which this inferior variety matter figures in our market problem is had from the following quotation from a Washington newspaper of recent issue. It refers to the holdings of a single association, of a single district (and one of the best in the Northwest) in a single storage center:

"There is now in storage in one of the Eastern market centers 100,000 boxes of association apples, of which the number of varieties is 79. Most of this fruit is of inferior varieties, and should not be grown here. We should reduce our varieties to ten at most; not to exceed six or eight, as a matter of fact"

The foregoing pronouncement is absolutely correct. The aggregate of these inferior varieties becomes appalling. The future holds absolutely no hope for common varieties. It is worse than "shipping coals to Newcastle" to ship them to the East, where they can be produced at far less cost, and of equally good and sometimes better quality. The sooner we in the Northwest eliminate them, the better, for meanwhile they are a positive detriment to our industry.

Weaknesses of Co-operative Marketing

The third count in our self-indictment is voiced in the following quotation from Report No. 98, United States Department of Agriculture, on "Systems of Marketing Farm Products":

"Certain weaknesses have appeared in co-operative marketing as in co-operation for other purposes. The business cannot thrive under an incompetent manager; the board of directors must not nag the manager and require him to accomplish results without the power to do so; deficient capital is fatal, and credit in buying and selling is often so. A common weakness of these associations is found in desertions by members; instead of selling all their products through the associations, they sell some of them through other channels. If a competitor offers to a member a higher price than he gets through his association, he sells to the competitor. Sometimes the business of the association is too small, so that the percentage of receipts that must be devoted to expenses is fatally high. A weak spot in co-operation, frequently observed years ago, was the fact that some of the operators looked upon co-operation more as a means of social reform than of economic benefit. Social theories and enthusiasm are usually detrimental to success."

Extravagance in administration on the one hand, false economy on the other hand, loose systems of finance, accounting and warehouse administration, all contribute to the leaks that, unless stopped, are fatal to any business, as well as de-

structive to the mutual confidence which is the basis of co-operation.

The next point to be considered is the amazing short-sightedness of our industrial sales policy. We have done practically nothing to create and stimulate a demand for our own products. We have moved along the lines of least resistance. We have had no very clear idea of how our product reached the market and no concern about what became of it when it got there so long as the price of it was in our pockets.

At last, stung by a touch of adversity out of our erstwhile complacency, but still without general understanding on the part of our rank and file of the media and processes of trade, and the laws of merchandising, it is perhaps natural that in the general confusion of the public mind, and the general desire to fix the responsibility for our misfortunes, we are disposed to take a crack at every head that shows itself—the middleman, the railroad company, the sales agency, the manager of the local association. Because it is human nature to fear and distrust, most, the things that we least understand, those factors farthest from us come in for the larger share of the blame. Whereas, I repeat, nearly all of our trouble comes from within, not without, and from our misconception of our problem.

Nature of the Problem

In the first place, ours is a manufacturing and merchandising problem, rather than one of simple farming. Therefore, we must employ the methods of the manufacturer-merchant rather than those of the farmer. We are manufacturing an article of food, which we desire to place in the hands of millions of consumers, all over the world, taking in exchange their money. Our problem is, then, the delivery of our products into the hands of these millions of consumers in the most economical manner, and the return of the money to ourselves in the shortest possible space of time, and with the least possible cost of service. The processes by which these things are done under modern conditions of civilization are always complicated, but in our case are rendered infinitely more so by, first, the perishable nature of our merchandise, and, second, the isolation of our plant from the markets. Our factory is 2,500 miles distant from the average of our markets. What is the solution of this problem?

In the writer's judgment, the solution lies in intelligent, universal co-operation. Co-operation is a word freely used, but, unfortunately, not always understood, and most often the user of it does not think of co-operation as extending beyond himself and his neighbors. The writer would have you think of it as applying all the way down the line, from the producer, through the bankers, the railroads, the wholesalers, the retailers, right up to and including the ultimate consumers of his merchandise. He would also have you remember that education is the companion of co-operation.

Co-operation Amongst Ourselves

This we are learning gradually to do, though as yet we have gone but a little way along the road.

Co-operation With Bankers

Fortunately, the bankers are being roused to their responsibilities toward the industry and an appeal made to their intelligent self-interest. It is to be hoped and confidently expected that soon they will accept their full share of that responsibility and help to work out a system so safe and so conservative that they can afford to lower their present almost prohibitive rates of interest. In this connection, consider the history of the largest single fruit industry in the United States—the United Fruit Company. This company started out with $10,000,000 capital, and undertook to reorganize a business that was unprofitable and unsatisfactory to all concerned. Their capital is now $36,000,000. They have paid during the last four years 25 per cent dividends on thirty odd millions of capital and accumulated profits of $16,000,000. Their securities in the New England market, and in Boston on the stock exchange, are considered so stable that the savings banks and the conservative bankers and brokers recommend them to widows and children as investments. This, too, in spite of the fact

that the banana is so much more perishable than the apple that there is hardly any comparison. They are, in fact, almost as perishable as strawberries. They will chill at a temperature of 50; in fact, 55 is considered dangerous. They will cook at a temperature of 65 to 70. So that the problem of transporting bananas from Central and South America in steamers, transshipping them under all sorts of weather conditions at seaboard, and forwarding them across the continent to Pacific coast cities, even to Alaska, as well as to England and the continent of Europe, is an exceedingly difficult and complicated one.

Yet all these things have been worked out successfully, and the company has, through its own intelligent effort, made the banana an article of household consumption in every hamlet, town and city, not only in this country but in Europe, where, prior to the organization of the company, American bananas were unknown. During the early days of their introduction in Europe, the company had also to overcome the determined opposition of the dealers, who denounced them as vegetables rather than fruit. So, the point to be made is that the perishable nature of the fruit business does not indicate that under proper organization it is a business of too great hazard for the banks to figure on as closely as they would on any other article of merchandise.

Co-operation With the Railroads

The physical side of the industry should be so organized that the transportation risks of the railroads are reduced to almost a pig-iron basis, thereby saving them tens of thousands of dollars annually in loss and damage claims. Growers should co-operate with them, and they with the growers in the supply of adequate storage facilities at shipping point, whereby we not only serve ourselves but also relieve them of the almost impossible task of supplying sufficient refrigerator equipment to move our whole crop in six weeks. Then can we go to them for recognition in the way of reduction in rates proportionate to the reduction in their risk and expense, and with confidence in their reasonableness.

Co-operation With the Middlemen

Before denouncing them as parasites and demanding their elimination, let us first study them and examine into their relations to ourselves and to the consumers and see whether they are not men, like ourselves, neither better nor worse than we, and whether they are not performing a useful service and doing it better than we could ourselves, and therefore entitled to their place in the economic scheme of our organization. If, after we have made a thorough study of the subject, it appears that there are superfluous middlemen, then the superfluous has no justification for existence, and should be eliminated. If we find that abuses exist among the middlemen let us by co-operation and education eliminate the abuses.

What is a middleman? The United States Department of Agriculture (Report No. 98) describes him thus:

"In addition to finding purchasers for commodities on the market, securing goods for persons intending to buy, attending to transportation and storage and making and transmitting collections of money, the functions of a middleman may include also the collection of small lots to make a carload, shipload or other large unit desired by a certain buyer or class of buyers; and likewise the middleman may serve to distribute a large consignment among many purchasers. A carload of berries is too much for an average retail merchant to handle; it is generally necessary to secure a number of such buyers in order to dispose of a car of such produce. On the other hand, the trade in fruit, as in many other farm products, is conducted over such a vast extent of territory and in such large quantities that it has become necessary for most of the individual consignments to be of considerable size. Freight rates and conditions of freight service make it almost necessary that shipments of most farm products be made in car lots. Hence the double service of collecting small consignments into carloads and of distribut-

ing carloads among many buyers has become a necessary part of the present system of distribution."

With reference to the "Elimination of the Middleman," the government report says:

"Co-operative marketing does not necessarily, and in fact, often does not, eliminate any middleman in the process of distribution. . . . It often happens that when the middleman is eliminated by the association his services are performed by the association itself. There has been a transfer of service from one to another, but no discontinuance of the service."

Middleman an Economic Factor

From the foregoing, then, the logical conclusion is that certain middlemen between producer and consumer are necessary economic factors, and the point to be determined is whether the middlemen now existing are performing their function in the most economical manner, and whether we, as producers, can perform their functions at a lower cost to ourselves than they can perform them for us. That is really the first step in our problem of distribution. The writer is satisfied, from 12 years of active experience in the marketing of both manufactured and raw products, that the elimination of the essential middleman is impractical and impossible, at the present stage of social and economic development In his judgment, the essential middlemen in the fruit trade, other than the associations and sales organizations of the producers themselves, are the wholesale fruit merchants and the retail fruit merchants. For years, the question of the elimination of the jobber has troubled manufacturers of every sort of commodity; the brightest minds in the country have wrestled with the problem; millions of dollars have been spent in experimenting to that end, and in the vast majority of cases it has been proven, to the complete satisfaction of those concerned, that the jobber has a clear title to his economic existence, because of his ability to perform his function, spread as it is over a multitude of productions, more cheaply than the manufacturers or producers of those separate commodities could perform it individually. There have been a few producers who have found it possible to eliminate the jobber economically; but there have been special reasons for these exceptions. Everyone of them have been based on a commodity which is consumed in great quantities by the masses, and which has an all-the-year-round sale. Even with these conditions in their favor, the elimination of the jobber has involved the expenditure of huge sums of money, for where the jobber is eliminated, the producer must replace his services; the building of warehouses in every city; the maintenance of warehouse and office forces at every point; the extension of credits to the retail trade, which in itself is a giant undertaking, the maintenance of delivery equipment, etc. It is perfectly manifest that no such undertaking is practical in our case, for many reasons, but one is enough, viz.: ours is a season commodity; ours is a six-months' business, and the economic waste involved in the attempt to replace the jobbers' facilities by our own would be unthinkable. If then, it appears impractical to eliminate the jobber, let us see whether there are not abuses in the exercise of his function.

Reciprocal Relations

Most certainly, in many cases, there are, but we ourselves have, unconsciously perhaps, but certainly, contributed to the growth of these very abuses. Therefore, let us co-operate with the jobber in the correction of these abuses. Once you convince him that you are in earnest and mean to give him a square deal he will meet you more than half way. It is a familiar complaint with us that the jobber exacts an abnormal profit and thereby curtails the consumption of our fruit. The facts are that the history of the fruit trade for 10 years past shows that the trade has lost money on their apple purchases every other year, and made money every other year. The trouble with us is that if we think of him at all, it is that he ought to contribute his services every year at cost, or less. How many of

us in the past, having sold our crop at a satisfactory price and delivered our apples to the buyer, ever gave another thought to our customer, or cared a rap whether he made a profit or a loss?

Frequently, too, we ourselves have robbed our customer of a profit on his purchase by shipping to his competitor in his home market other fruit to be sold on consignment. It happens time and again that we, consciously or unconsciously, have misrepresented our product in making sales, and on other occasions have subjected our customers to loss by dishonesty in the preparation of our produce. In other words, both by active and passive means—by what we have done as well as what we have left undone—we have contributed to the abuses which we are prone to lay solely at the door of our neighbor, the middleman. The writer does not wish to be misunderstood as charging the growers, as a class, with deliberate dishonesty. On the other hand he believes that most of them are just as honest as most of the middlemen, but he does wish to emphasize that what is needed is a system which will protect us from our own dishonesty, and which will protect the jobber from our dishonesty, protect the jobber from his own dishonesty, and protect us from the jobber's dishonesty. System, education and co-operation alone can accomplish these things. In the development of this system we have been sadly lacking. And in this omission we have injured ourselves far more than anyone else has injured us. The up-to-date manufacturer-merchant studies the progress of his merchandise all the way from his factory to its ultimate consumer. He follows it long after he has been paid for it by the jobber. Right now the Department of Justice at Washington is prosecuting a manufacturer of a well-advertised breakfast food for making an agreement with retail grocers under which they were forced to take a reasonable profit, and were not allowed to cut the price. Hundreds of manufacturers in every line of merchandise are finding that the tendency of the trade is not to make an abnormal profit, but, under stress of fierce competition, to sell popular brands of merchandise at cost or less than cost. Knowing that sooner or later this will react upon himself, the manufacturer resorts to every lawful means to maintain the selling price of his commodity. And the writer knows from experience that it is the most difficult thing in the world to do. Therefore, the matter of exorbitant profits is an abuse which is comparatively easy to correct, if we but choose to take a hand in the game and play it according to the well-known rules which are an open book to all men of business experience.

Our "Specialty Line"

The first thing we need to do is to recognize the perfectly self-evident fact that what we are producing is a "specialty line" rather than (in the trade sense) a staple The high level of our investments, the high cost of production, heavy overhead expenses, high cost of transportation, all contribute to the necessity of producing an article which can be sold at a price at which only the more prosperous classes of the people can consume. The distinguishing features of our commodity are superior appearance and attractiveness, and its package. These are also distinguishing features of nearly every manufactured, advertised specialty. "White House Coffee," "Quaker Oats," "Cream of Wheat" are all advertised brands—specialties—of staple bulk commodities. Shorn of the brand value, created by advertising and careful packaging, and sold in a paper bag, the same merchandise would cost the consumer about one-half of its actual price. Take for example "Cream of Wheat." The contents of this package consist of wheat farina. Bulk wheat farina is quoted on the Portland market today at $3.25 per 100 pounds wholesale; "Cream of Wheat," $5.50 per case of 36 packages, the net weight of which is 1 pound 13 ounces, or 65 pounds net per case. Sixty-five pounds of No. 1 wheat farina in bulk would cost $2.11, or 38 per cent of the price charged for the packaged, brand-copyrighted, advertised article. Cream of Wheat is manufactured in the East; a local prepara-

tion manufactured on the coast, and packaged, is offered at $4 per case of 36 packages, against $5.50 for the Cream of Wheat, but the Cream of Wheat sells better than either the local packaged article or the bulk article, for the reason that its manufacturers have convinced the consumers, through advertising, that it is better.

An almost perfect analogy exists between Cream of Wheat vs. bulk farina and Northwestern boxed apples vs. the Eastern barreled (or bulk) product. Any difference is in our favor. If the analogy is real and not merely apparent it behooves the producers of boxed apples to study the elements of their merchandising problem and take instant steps to modernize their selling system.

Value of Advertising

For seven years the speaker was connected with the sales and advertising departments of the manufacturers of "Force," the well-known breakfast food. Those manufacturers appropriated $1,000,000 for advertising before they turned out one single package from their mills. The manufacturers of Cream of Wheat probably did the same thing, and what is more important and significant, they maintain their advertising year after year, for without it competition would soon drive their article out of the markets. Compare this performance with ours. The comparison isn't very creditable to us.

Suppose a company were organized with $250,000,000 capital to manufacture an article to compete with Cream of Wheat and were to build a magnificent factory, equip it with the most modern machinery, turn out large quantities of the manufactured product, induce the wholesale grocery trade to buy a stock of it and then stop right there. What would happen? Why only one thing could happen. The wholesaler would find the article hard to sell, and would push other articles of easier sale; the retailer would be slow to take hold of a new article for which there was no special demand from their trade, and the manufacturer would fail. That is just as certain as daylight. But no manufacturer would do any such thing. If he did, his bankers would have a lunacy commission appointed for him. What the manufacturer would do is to appropriate a sum of money out of his capital and devote it to the creation of a demand for his article, through advertising, and create that demand from the ultimate consumer. He would naturally depend on the merit of his article to please, but he would continue his advertising campaign year after year, as long as he was in business, to defend his business against competitors. Under these conditions a whole new situation is created. The retailer would find the consumers calling for his brand, and would have to buy a stock of it in self-protection, because if he didn't his competitor across the street would. The wholesalers likewise would send to the manufacturers for a supply. But whether the retailers and wholesalers did this gladly or not, the point is they would do it. This accomplished, the manufacturer would own a brand which would increase in value every year, and which would be superior to the fluctuations of the open market for bulk commodities.

Where the Grower Failed

Now, who will say that the boxed-apple producer of the Northwest is not in very much the same ridiculous position of the manufacturer mentioned in the first instance? Ours is an investment of $250,000,000. We have provided a magnificent plant and equipped it with the most modern devices; we have produced a specialty article of high merit, and have packaged it conveniently. But, after unloading our product on the buyers at prices which have fluctuated violently from year to year, we have stopped—dead; and thought our job was done. We have expected the jobber and retailer to push our product to the consumer, not caring whether they made a profit or a loss. In fact, any suggestion of profit by any middleman has been rather offensive to us. Yet, we have expected these men to push our product, and thereby displace barreled and bulk apples on which the dealer, perhaps, has invested

his money, and on which he can and does make a satisfactory margin of profit.

Must Finance Our Own Selling and Advertising

We, as manufacturers, have got to finance our own selling and advertising campaign. We ought to know by this time that the dealers are not going to do it for us. We have got to vitalize our selling system and abandon the primitive methods which work, perhaps, in the sale of cheap bulk commodities but which will not develop and maintain our trade in markets which are right in the heart, as it were, of the Eastern apple orchards

The food manufacturer, even after appropriating large sums for advertising, does not expect his article to be sold without active work on his part. So he sends trained salesmen into the markets, not primarily to sell the wholesaler for shipment from the factory, but to work the retail trade. The wholesaler is the last link in the chain to consider, though an important one. The manufacturer's salesman calls on every grocer in town and takes orders for as many cases of the commodity as the grocer is willing to buy. These orders are assembled, taken to the wholesalers, and the wholesaler's order is taken for several times the amount of the aggregate of the retail orders. The retailers are sold at a fixed price, which allows them a fair margin of profit when sold at the advertised price to the consumer. The jobber, in turn, is allowed the customary jobbers' discount. From first to last, the manufacturer, whose business it is, takes the initiative and assumes the expense. He can afford to, as his campaign is going to enable him to sell his product for a much higher price than would otherwise be possible. It is only by these necessary expenditures that he can accomplish his object. Having taken these steps, the town is ready for the advertising, and not before, for if the advertising were to be sprung prematurely the consumers would call once or twice for the article, would not find it in the stores, and the campaign would fail.

Value of a Brand

The foregoing is a plan which, in my judgment, is perfectly practical, with certain modifications, to apply to our industry. The course I would propose is to select a brand with a catchy name, copyright it, and allow it to be used only by strictly reliable packers, under a revocable license, and only on a few high-class varieties, and only on the extra-fancy 150 size and larger of those varieties. The brand would appear on the wrappers and also on the box. On the maintenance of the quality of this brand would depend its success, so too many precautions could not be taken to see that every box bearing the brand is strictly up to grade. The next move would be to select one state in the Union in which to make a thorough test of the plan. Let us say Indiana, as that state is not only rich and populous, but at the same time one of the poorest consumers of boxed apples in the Union, relatively. Indianapolis is a rich, prosperous city of 253,650 inhabitants. Start, say, in Indianapolis, with the special brand of Jonathans and Grimes Golden. I would ship several carloads of the brand to Indianapolis, either placing them in storage temporarily, or else timing their arrival conveniently. The next step would be to send one or two thoroughly trained, experienced specialty salesmen there. I could lay my hands on just the right men in a moment. I would have a thorough canvass of the retail grocery trade made, and also the fruiterer trade. There is about one grocery store to every 200 of the population; fruiterers additional. This would make 1,168 groceries alone in Indianapolis. Not over one-quarter to one-half of these would be good stores in good parts of town. Say about 300 in all. The "live wire" salesman can work about 25 grocers in a day if he has a quick-talking proposition, which this would be. In two weeks' work one man could cover the town pretty thoroughly. Have this salesman explain to the grocer the extraordinary quality, appearance and merchantability of the product; the convenience of the package; the advantage of co-operat-

ing with the producers to work up a box trade, which would avoid measuring, bags, string, etc., and save him money all around. Under which conditions he could afford to handle the fruit at a reasonable profit, especially as there would be no waste or loss by decay. Any "live wire" could make a friend and a co-operator of that grocer. Without going further into the argument, suffice to say that a "whirlwind campaign" could be made. Explain to the grocer that on a certain morning a full page "ad" will appear in the Indianapolis newspapers written by an expert, so as to command instant attention by every housekeeper in town. And that in that ad. a full list of the grocers and fruiterers who can supply the fruit will also appear. That is a good ad. for the dealer. That advertisement will state the price per box at which the consumer can buy this brand by the box from the grocer. That would be the first intelligent step ever taken by Northwestern producers to regulate the profits of the retailer, and it would be doing it in a way that would not make the retailer our enemy for life, but would have his full approval. Then take the order of the retailer for five, ten, fifteen or twenty-five boxes of the advertised brand for delivery through his wholesale grocer or wholesale fruit merchant. Perhaps under this system the wholesale grocers throughout the country generally could be induced to carry boxed apples, like the wholesale grocers in Texas do now. If so, it would be another big advantage gained, as the wholesale grocers would not carry any but the advertised brand. Then assemble these orders on the various jobbers, deliver them, and get the jobbers' order for a generous stock over and above what we have sold for them. By taking the retailers' orders at a fixed price, you can then allow the jobbers a fair margin of profit and no more; but this time you have not only limited his profit, but you have forced him to buy, and you have done it all without making him your enemy for life, but have made of him, too, a co-operator. In conjunction with this campaign, if the advertising appropriation permitted, it would be well to have a couple of well-trained girl demonstrators who could be dressed in costume to represent the Western girl; perhaps in cow-girl costume. Merely walking along the street would set the whole town buzzing. Have them take baskets of sample apples and go from house to house in the better sections of the city, get interviews with the housewives, leave a little cook book filled with recipes and also with some needed educational matter on varieties, have her sample an apple of the sort we are selling, and then take her order on her nearest grocer for a box or two. It would also be entirely feasible to arrange with the Sperry & Hutchinson syndicate or some other of the trading-stamp or coupon exchanges, to accept our copyrighted wrappers as one coupon or a fractional coupon, interchangeable with United Cigar Stores coupons, Sunny Monday soap and a host of other premium coupons. This would attach a premium feature to our brand, and give us all the advantage of an organized premium department without having actually to establish such a department. Any man whose wife saves soap wrappers and pesters him for cigar coupons knows how strong an appeal they are to the children and women, and to men as well. The desire to get something for nothing, being human, is just as strong with the prosperous classes as with the poor. If this plan were carefully worked out and properly executed the result would almost inevitably be: the thorough establishment on the markets so worked of the given brand and a steady repeat business for carloads from the wholesale dealers throughout the fall season. Later on, when fall varieties were exhausted, another ad. could be run on intermediate mid-winter varieties; later of the spring varieties. Another most important feature of this campaign would be the badly needed education of the consumer, the retailer and the wholesaler as to the correct rotation of varieties, and in a short time we could abolish such absurdities as Arkansas Blacks and Ganos selling on the fruit stands in Octo-

ber and November, to sicken and disgust the consumer and kill the demand, while Jonathans and Grimes Golden are being ignorantly held in storage.

Educating the Consumer

So, by this plan, the consumer also will have been educated by us, whose business it is to educate him, and it will have been done right. The effect would be lasting, as we will have made a friend of the consumer—a co-operator.

This is my idea of co-operation. Co-operation that is intelligently constructive, not destructive. Destroy the abuses as we find them; yes. But let us be sure we have found them first, or we may destroy something that is inherently valuable, and only needs a little sympathetic co-operation to contribute to our needs.

The progressive methods that I have proposed will cost money, assuredly. But spread out over a large volume of business, with growers co-operating and supporting, the per package cost would not be high. Three cents per box would do a very great deal; 5 cents per box would do more, and in my judgment would return in increased profits many fold. Our industry has reached a point where such methods are not an extravagance, not a luxury, but a necessity. We have got to spend money to make money.

It may not be a violation of the proprieties if I illustrate the principles which I have sketched by referring to the institution with which I am connected—the Northwestern Fruit Exchange. Organized at the beginning of the shipping season of 1910, the exchange has expended $150,000 in the development of a system of merchandising, specifically adapted to Northwestern fruits. We firmly believe in the principle of f. o. b. sale, for many valid reasons. First, it is the accepted and proven system by a great majority of the successful fruit industrials. The United Fruit Company sells 75,000 cars of bananas annually on a f. o. b. basis strictly. The California Vegetable Union, American Cranberry Exchange and scores of others, the most successful in their several fields, all operate on this principle. We contend that the fruit is worth more, f. o. b. shipping point, than at any other point; worth more intrinsically; worth more as an article of merchandise for the merchant wanting it for immediate sale; worth a good deal more to the merchant wanting it for storage purposes. It would therefore seem that the shipping point is the place where it would be most desirable for the grower to have his market established. At that point we can absolutely guarantee, if we are careful enough, that the fruit is strictly first class. We cannot do that—absolutely—24 hours after it has left shipping point, but we can say everything good about it while it is at shipping point that could possibly be said about the fruit, and say it truthfully. Again, if the market is established f. o. b. it means the crop is a cash crop to the fruit growers. With interest rates ranging from 8 to 12 per cent, that in itself is a big item. As a matter of fact, the exchange made a record for the entire season of 1911 of an average of 24 days between date of shipment and date of full payment for every car handled during the season. Furthermore, during the season of 1911 the exchange sold for one association that I could name nearly 75 per cent of its entire output prior to the harvest of the fruit from the trees, and 99 per cent of the whole f. o. b. shipping point.

Sales Department

Another very important feature of our problem which shows the great need of co-operation is in the operation of the sales department. The exchange believes that there is only one system which is practical in a large sales operation of perishable fruits, namely, resident salesmen. The value of any commodity is based on supply and demand. In order to obtain maximum value, the sales manager must have at his daily command the whole demand of all the markets of the world. Traveling salesmen as a main system is expensive and impractical. I know of one large producer who tried that system, and he says it cost him $200 per car to sell his fruit at unsatisfactory prices. The trouble is that the

traveling salesman and the demand only meet by accident. It takes one man 30 days to cover the state of Iowa throughly. When he is in Keokuk the demand may be in Council Bluffs, and vice versa. The average fruit dealer buys from hand to mouth and does not anticipate his wants very far ahead. Only a few of the larger operators in the big cities do that. That the principle of resident salesmen is correct, it is only necessary to point out that practically everyone of the large successful organizations have adopted it; the California Fruit Growers' Exchange, the United Fruit Company, etc. In the same government publication from which I have already quoted, appears the following:

"The co-operative marketing association keeps itself well informed with regard to prices and market conditions in all the markets in which it sells or can sell its goods. This is done by means of telegraphing. The prosperous marketing association doing a large business at the present time expends a large amount of money in telegraphing. The annual expense of the Eastern Shore of Virginia Produce Exchange for telegraphing is about $25,000, and the annual expense of the California Fruit Growers' Exchange, which handles the principal portion of the citrus crop of California, is $75,000. The best success of the marketing association necessarily depends on a knowledge of the best markets in which to sell the products. The manager of the association must in effect be in every market in which he sells and all the time."

Obviously, under a system of traveling salesmen, this would be impossible. Do not misunderstand me—traveling salesmen are all right, as an auxiliary, but not as a system.

Resident Salesmen

In the presence of the necessity of having resident agents in all the markets, the problem that confronted the exchange (and it is the problem of the whole industry) was how to maintain, without assistance, such a comprehensive and costly system. The California Fruit Growers' Exchange can do it, as they are dealing in a commodity which is packed and shipped from California every day in the year. Their system of sales branches costs them, so I have heard, $25,000 per month, or $300,000 per year. The United Fruit Company can maintain 52 branches of their own throughout the year, and without assistance, as they, too, have a product which is shipped the year 'round. But we in the Northwest are dealing in a commodity which is harvested through a period of about 100 days, and marketed through a maximum period of about six months. No matter, then, what our total volume, we could never afford to maintain a branch office system without assistance, unless we wish deliberately to adopt an economically wasteful method. For, with the salesmen busy six months and idle six months, there would be not only an unthinkable economic waste, but also deterioration in the men. No man can work actively for six months and loaf the other six months and be as good a salesman or business man at the end of his six months' idleness as he was before. Besides all this, the men would fall out of touch with the trade and become rusty. Had the exchange been unable to find a solution to this question before it started business, it would never have started. It found the solution in operation. It found there were other associations in other parts of the United States producing other and non-competitive fruits and vegetables, whose commodities came into the market at opposite or nearly opposite seasons to ours, and who had the same need for resident salesmen that we had, and who had also the same economic problem. And by intelligent combination of these factors a tonnage was provided that rotated all the year 'round, and the service thus co-operatively established was put in charge of specially trained superintendents and has worked beautifully, and at a cost vastly lower than any one of the co-operating concerns could have created it independently. At the present time there are 123 branch sales offices in the exchange system. Each of these offices is responsible for a certain territory in its vicinity. Thus we aim and come very near to being in contact every

day of our active season with every one of the 10,000 carload buyers of fruit in the United States and Canada.

Foreign Markets

Recognizing from the first the importance of developing the foreign markets to their capacity, the exchange sent the writer to Europe last summer to make a personal study into the conditions and establish such connections as were necessary. As a result of that investigation the exchange decided to establish its own office in London under salaried management, and was most fortunate in the opportunity of engaging as manager of the office a fruit man of unusual training and talents, trained in the business on both sides of the water. An exclusive agency was also established in Germany, the exchange agents controlling the only system of fruit branch houses in Europe. These branches are in Duisberg, Cologne, Essen, Frankfort, Mannheim, Leipsic, Dresden, Munich, Berlin and Hamburg, the headquarters being in Bremen. The managing director of the agency, by special arrangement, visited the Northwest in August and September, making a careful study of conditions here in order better to fit him for the work.

Value of Foreign Markets

However, I feel that there is danger of overestimating the capacity and the extent of the foreign markets. In fact, I think they are already being very generally overestimated. The fact is that the capacity of Germany at the present stage of her industrial development is not much over 250,000 boxes of Northwestern apples per annum, at profitable prices. More than that amount is being shipped there this season, but the results have been that for the past few weeks at every sale in Hamburg there have been from 20,000 to 30,000 boxes of apples offered and out of each sale from one-third to one-half left unsold for lack of a bid. It must be remembered that by the time first cost, transportation, duty, interior freight, high taxes, etc., necessary to deliver a box of our apples to the interior of Germany, are added, the result is an article of luxury, which only the rich man can afford to buy. It is not for the man in the street who earns from two marks to four marks daily. Again, the great difference in the value of money must be considered. Four marks, German, is about $1, American, so that a box of apples which sells for $3 in Germany is the German equivalent to about 12 marks. But one mark (23.8) will buy in Germany, in the necessaries of life, what $1 will buy in America. So that the man who pays $3 for a box of apples, or 12 marks, is really exchanging, in terms of the necessaries of life, not 12 marks but $12. There are not many Americans who could afford to pay $12 per box for apples. Nor are there many Germans. Perhaps when freight rates are lower, and as the condition of the working classes in Germany improves, ways and means may be found to increase the consumption materially. The foregoing is also true, to a large extent, of England as well as Germany. And even more so of other European countries, where money is even cheaper than in Germany. Heavy duties limit the introduction of our apples in Russia; also in France. There is a small business in Scandinavia, but the total population is not great and the masses are poor. All of these markets are easy to congest, and under such conditions they are far less elastic than American markets of similar size, and are liable to slump very violently and disastrously.

Outlet for Surplus

I do not wish to be understood, from the foregoing, that I am not in favor of developing the foreign markets. On the other hand, the exchange has shown that it does believe in so doing, in the most practical way. But neither do I believe in building castles out of thin air. The foreign markets, in my judgment, will prove to us, as they have to most other American manufacturers, chiefly valuable as an outlet for our surplus, which we can use to take the pressure off our home markets. We shall have to make our money in our home markets, and, save in exceptional years, will have to sell our goods in the foreign markets at something under American parity. There

are other parts of the world in which markets may be developed besides Europe. There is South America, the markets of which have been partially developed, but which this year (1913) have been glutted with Northwestern apples, partially due to insufficient cold storage accommodations which are necessary because of the infrequent steamer service. Then there is South Africa, which appears to offer a market at certain seasons of the year. Australia has been partially developed, but the trade is limited on account of the insufficient and infrequent steamship service. There is some market in the Philippines and a small market in the Orient. Of the exact conditions in some of these markets very little reliable information is available, and the exchange is now considering the employment of a foreign trade commissioner to cover the markets of the globe and make a close personal study not only of their present capacities but of their possibilities. This tentative plan of the exchange will be put into effect in the near future with the approval and support of its co-operative membership. Also with the approval and support of its members it proposes to put into practical working effect next season its policies of advertising, exploitation, education and co-operation all down the line straight to the consumer.

W. F. Gwin,
Gen Mngr Northwestern Fruit Exchange

THE HANDLING OF DECIDUOUS FRUITS ON THE PACIFIC COAST

Picking, Packing, Precooling, Etc.

The fruits classified under the general term deciduous fruits are those produced by trees which drop their leaves in winter. They are called deciduous to distinguish them from citrus fruits, which are borne on evergreen trees. The fruits which come under this designation, and which are shipped in a fresh state from the Pacific coast, include apples, apricots, cherries, peaches, pears, plums (including prunes), nectarines, grapes, and the small fruits, such as strawberries,* raspberries, and blackberries. The handling problems included in this article refer to the preparation of the fruit for shipment and for marketing in the fresh condition, although the greater part of the deciduous fruits grown on the Pacific coast is marketed not in a fresh condition, but as canned and dried fruits of all kinds, including prunes and raisins.

* While the strawberry holds its leaves through the winter, its fruit is similar to the deciduous fruits in its shipping requirements, and it is therefore classed with them

There has been an enormous growth and development of the deciduous-fruit industry on the Pacific coast. Up to 12 years ago most of this development had been in California, where the fresh-fruit shipments in 1909 equaled 15,280 carloads, but recently the planting of deciduous-fruit orchards in the states of Oregon, Washington, Idaho, Colorado, and Utah has been made on a very large scale. The development of these new districts and the rapid increase in the production of deciduous fruits have alarmed many of the growers, especially in California, at the possibility of overproduction, and the advisability of adopting means to prevent further planting, or at least to stop overdevelopment and the booming of new regions by land speculators, has been seriously discussed. Plans are being made to increase the demand for and consumption of these fruits by advertising and by the development of new markets. It is at last realized that too much attention has been given in the past to the business of inducing people to plant fruit trees and that not enough consideration has been given to the selling of the crop and to finding a profitable market for the fruit that is already on hand.

Transportation Problems

The problems connected with the transportation of deciduous fruits from the Pacific coast are essentially problems growing out of the necessity for wide distribution. Ever since the first carload of fresh fruit was shipped from California, in 1869, the bulk of each crop has had to be marketed in the Eastern states. It is a remarkable fact that this business, built up on the far western edge of the continent, has been and will for many years continue to be almost wholly dependent upon

the Atlantic seaboard and adjacent states for a market. The fruit has to be transported 3,000 miles, crossing lofty mountain ranges and hundreds of miles of desert, to the cities and centers of population of the East and Central West. Great engineering problems have had to be solved in accomplishing this result. It is stated that in crossing the continent a car has actually to be lifted or raised a vertical distance of more than two miles. Upon the safety, efficiency and despatch of the transportation facilities depends the whole success of the fresh-fruit industry of the Pacific coast. The perishable nature of the product and the difficulty in handling such an industry 3,000 miles from the center of consumption have made it necessary to develop an ample and efficient fruit-refrigerator-car service, which is now admitted to be the largest and best of its kind in the world.

The distance which the fruit has to be transported and the expense and risk involved necessarily require that the fruit reach the market in the best possible condition. This has enforced a degree of uniformity in grading and packing which, together with the high shipping qualities of the Western fruits, is largely responsible for the successful marketing of the Pacific-coast product in competition with the Eastern fruits produced near the markets, but which, taken as a whole, are not as attractively or uniformly packed. The diffficulties and the expense of shipping and marketing the Pacific-coast fruits to some extent safeguard the grower against the temptation that confronts the Eastern grower with nearby markets and lower freight rates, to attempt to market large quantities of inferior, badly graded, and poorly packed fruit.

It must not be assumed that no poor packing is done and that no poor-grade fruit is shipped from the Pacific coast. In fact, much of the Western fruit has the reputation of being poor in quality, though often beautiful in color and fine in appearance. This reputation has not militated to any great extent against the sale of Western fruit, owing to the fact that the consumer has thus far bought fruit products principally on appearance. But as competition grows keener and as high-grade fruit from nearby sections comes to be more carefully and attractively packed so as to reach the market in sound condition, fruit of poor quality will suffer. The poor quality of some of the Western fruit, especially the peaches, apricots, plums, and other quick-ripening fruits, is the result of picking long before the fruit reaches full maturity in order to protect it against the ripening which takes place during the transcontinental trip. After fruit is picked the ripening processes progress much more rapidly than they do under the same conditions of temperature while the fruit is on the tree. Unless some means are employed to check this ripening as soon as harvested the fruit is too far advanced, even under the present method of refrigerator-car shipment, before it reaches the market.

Handling, Packing and Marketing

The deciduous fruits are produced under the most diverse conditions—in the valleys, in the foothill and mountain districts, under irrigation, and with natural methods of tillage. Under such varying and extreme conditions the product varies in quality and appearance as well as in season It is owing to this diversity in the conditions of production that the problems of deciduous-fruit handling and of marketing have not been systematized and organized as they have been in the citrus-fruit industry. The citrus-fruit industry is largely organized into associations of growers. The fruit of the different growers is uniformly graded and packed in central packing houses owned by the association, each packing house having its own brands to designate the different grades. The fruit is not shipped under the name of the grower who produces it, as all of the fruit of the same grade is pooled. Many of the associations of growers also pick and haul the fruit of the members to the packing house. They have developed trained gangs of pickers and other laborers who work under efficient foremen, and they, more than those engaged in any other agricul-

tural industry in the country, have evolved methods to insure the careful and uniform handling of the product.

In the handling of deciduous fruits this system does not prevail except in local areas. There are few central packing houses except in some of the grape districts in California. The greater part of the deciduous-fruit crop is packed in the orchard where it is grown, usually by the grower, except in some of the apple and other fruit districts in Oregon and Washington. While certain standards of grading and sizing are supposed to exist, they fall far short of the uniformity prevailing in the grades and brands of citrus fruits. When packed in central packing houses each grower's fruit may hold its individuality until it is sold. The establishing and maintaining of uniform grades and brands, except in the case of growers having a large acreage, is impossible under this system. It frequently happens that a carload consists of fruit from 25 to 50 growers, each packing and handling in his own individual way. It naturally follows that there is the widest variation in the packing and grading, although the shipping companies have standards to which the grower must conform in a general way.

The one great object in growing fruit is to sell it at a profit. Fruit growing is a business and as such is dependent upon business methods and principles quite as much as the manufacture and sale of boots and shoes, of steel implements, or of other articles. The manufacturer realizes that the success of his business depends upon the proper distribution and sale of his products and he pays as much attention to the selling as he does to the manufacturing. It is the business of the fruit growers, either for themselves or through their agents, to study commercial methods and principles and apply them to their industry. With the establishment of better distribution and business methods in marketing fruits, the dangers from overproduction will largely be avoided.

This means, first of all, the production of first-class fruits, uniformly and honestly graded and packed and delivered to the consumer in sound and attractive condition. This is the business of the growers, and is the fundamental factor upon which depends the success of the industry. Too often the growers have ascribed the cause of their difficulties to others—to the shippers, to the transportation companies, to commission merchants, or even to the weather—losing sight of the fact that with the exercise of a little care and good judgment on their part many of these difficulties would not exist.

The fruit growers of the Pacific coast have mastered most of the problems relating to the production of the fruit—such as relate to the various orchard practices of tilling, fertilizing, pruning, thinning and spraying. It frequently happens that after a grower has used the utmost care in producing his crop he nullifies all through the handling he gives it in preparing it for market. It does not matter how excellent his orchard practices are, if his fruit does not reach the markets in sound and attractive condition he may find that he receives no more for his crop than a more careless or slipshod neighbor, and he is at a loss to understand why.

During the last eight years the Bureau of Plant Industry has conducted investigations of the factors which govern the shipment and storage of fruits. It has been shown by many experimental shipments that there is a direct relation between the handling and the treatment in all the various processes of preparing the fruit for shipment and its behavior while in transit or storage. This has to deal with the picking, packing, hauling, and cooling of the fruit.

Mechanical Injuries

It is generally recognized that fruit must be handled with great care if it is to be kept sound, but few have realized until it has been demonstrated to them, how easy it is to injure fruit in handling and how much injury is actually being done. In the investigations conducted by the Bureau of Plant Industry it was not uncommon to find 10 or 15 per cent of apples injured by rough handling

in picking and packing. Frequently, also, from 10 to 50 per cent of oranges were found to be injured by the clippers in severing the fruit from the trees or in handling it in the packing houses. Again, from 5 to 40 per cent of table grapes were found to be cracked or broken more or less severely at the pedicles.

The work of the Bureau of Plant Industry has shown that the more common kinds of molds which cause decay in transit and storage have not the power to penetrate the unbroken, normal skin of the fruit. It has been shown that molds generally gain entrance through mechanical bruises or abrasions of the skin made in the handling of the fruit in preparing it for market. Some common forms of such injuries are bruises and scratches made in the picking of the fruit, in squeezing it and dropping it roughly into picking boxes, bags, baskets, or pails, or in pouring it from the field bag or pail into boxes. Hauling on springless wagons (sleds are sometimes used) may seriously bruise the fruit. Dirt, gravel, dried branches, or twigs in the bottom of the field boxes are also a frequent source of injury. Injuries of these types are not only difficult to detect but offer ideal conditions for the starting of decay. Many fruits are injured by scratches made by the finger nails of pickers and packers.

In the case of soft fruits much bruising results from excessive squeezing in packing. The tips of peaches are most delicate and easily bruised or injured. In examining peaches in shipping and storage experiments tip injury is frequently found to be the greatest source of decay.

Grapes are perhaps the most easily injured of all fruits. An examination of grape berries shows that from 90 to 95 per cent of the injuries consist of breaks or cracks at the pedicle where the stem joins the berry. Sometimes the bending aside of a berry is sufficient to cause a slight rupture or crack at that point and all such berries are susceptible to decay when they are packed. This indicates the extreme care with which all handling of grapes must be done. Handling must be reduced to a minimum and always, when practicable, the bunches should be handled by the main stems, for every time a bunch of grapes is lifted there is danger of injury unless it is done with the utmost care.

Grapes are often injured in placing them in the baskets—by rough handling, excessive squeezing or crowding, or twisting and binding the long bunches to form compact masses. It has been shown that unbroken grape berries carefully handled and laid in loosely do not decay under normal conditions of shipment, and the nearer the packing can be made to approach this ideal condition the less will be the danger of injury and resulting decay.

Very soft fruits like cherries or berries are very easily injured, especially when these fruits are allowed to become over-ripe. It is important to have the picking operations keep pace with the ripening of the fruit. This means going over the cherry trees several times. Berry plantations at the height of the season must be gone over daily. The softer or more susceptible the fruit is to injury the more carefully must it be handled throughout all the processes of preparing it for shipment.

During the last two years the transportation investigations of the Bureau of Plant Industry have been extended to the table-grape industry of California. Careful observations on handling methods have been made and extensive shipping experiments have been carried on in order to demonstrate the results of careful handling in preparing the fruit for market. The experiments consisted of shipping a series of crates and boxes of grapes packed under known conditions through to New York, where the packages were carefully inspected and the actual percentage of decay were determined. The ordinary commercial pack was used in comparison with the same fruit carefully handled by the government investigators. Records on 50 such shipments were obtained during the shipping seasons of 1908 and 1909.

The records of shipments made in 1909 show an average of 1.2 per cent of decay

in the carefully handled lots and 5.8 per cent of decay in the commercial pack of the same fruit. Moreover, this difference was maintained after arrival in New York. The grapes were held for a week under open-market conditions, and determinations of the decay were made three, five and seven days after arrival. The carefully handled lots were still in merchantable condition five days after arrival, with an average of 5.2 per cent of decay, or less than the average decay found in the commercial packs on the day of arrival.

The decay in the commercial packs had reached 15.8 per cent five days after being received, and they were far past a marketable condition. The carefully handled lots had a great advantage aside from their better and sounder condition, in that they were in fit shape to be reshipped from large centers to smaller surrounding towns, thus allowing a much wider distribution and extension of the market. The importance of this fact can best be appreciated when considered in connection with the problems of overproduction and the possibilities of increasing the sale and use of the fruit. As long as the commercial packs continue to arrive at or near the limit of decay commercially allowable, the possibilities of reshipment are extremely limited and the market for the fruit is cut down accordingly.

In the careful-handling experiments with grapes and oranges nothing has been attempted which can not be done under commercial conditions. In the case of citrus fruits the piecework system has been changed to the day-payment plan, thus doing away with the tendency to rapid and careless work. In the grape industry no such radical change is necessary, as the day-payment plan largely prevails, but the pickers, packers, and all those who handle the fruit must be impressed with the necessity of doing their several operations with the utmost care. The fault lies largely in requiring as much and as rapid work to be done in a day as possible. Nearly every grower knows or believes that care is necessary, but very few realize how much damage is really due to requiring their help to work at topmost speed in order to get the work done as cheaply as possible. In many instances growers are astounded when informed of the amount of injury which is done. In the hurry and anxiety to get off as much as possible and to hasten all operations, the bruises, the scratches, and the punctures which result are too often overlooked.

Naturally it will cost more to handle the fruit carefully. At first sight it seems unreasonable to advocate spending more money in preparing fruit for market during seasons of low prices, but it has been found to be good business policy to make the increased expenditure. The saving in the quantity of sound fruit gotten to market will alone very nearly balance the increased cost. Using the average percentages of decay in the carefully handled and the commercial packs of grapes already noted, the saving in favor of careful handling amounts to nearly 45 crates per car, or a full carload of grapes for every 21 shipped, and this does not take into consideration the increase in market value and consequent salability of the sounder fruit, the price of fresh fruit being always depreciated by the presence of decay.

What has been found to be true in the grape industry applies with equal force to all other branches of fruit growing. Sound fruit of good quality, honestly and uniformly graded and packed, is the fundamental factor upon which the success of the business depends.

Refrigeration

Another factor of prime importance in the successful shipping of fresh fruits long distances is quick and efficient refrigeration. The deciduous fruits are all shipped during warm weather and must be kept cool while in transit. The full transcontinental trip requires usually from 12 to 14 days, which may be comparable to a period of about two weeks in cold storage.

As already stated, it has been found that the ripening processes are hastened

when the fruit is picked. The development of molds also goes on at a rapid rate while the fruit is warm. Reducing the temperature retards the ripening and prevents the development of the molds. The length of time that the fruit will remain in good condition depends upon the promptness and the thoroughness with which it is cooled.

Careful records made of many deciduous-fruit packages show that the temperatures of the packed fruit during the greater part of the season are extremely high. The range runs from 80 degrees to over 100 degrees F., and the average of all temperature records made is between 90 degrees and 95 degrees F. At such temperatures the fruit ripens very fast and decay and deterioration are extremely rapid, especially if the fruit has been roughly handled and injured to any great extent.

Records made in refrigerator cars show that the rate of cooling in the fruit packages is very slow when the ice of the car is depended upon both to reduce the temperature and to hold it low. It frequently happens that several days elapse before the fruit is cooled sufficiently to retard ripening and decay. This is the main reason why the Pacific-coast fruits are picked so long before they have acquired full quality. When they are not picked green, they become overripe and soften before the ice of the car has a chance to reduce the temperature below the danger point.

Frequently a very distinct advantage may be gained by allowing the fruit to remain open over night and packing while it is cool in the morning. More cooling can usually be obtained in this way than in one or two days in the refrigerator cars after the fruit is packed, especially where it is wrapped in paper. This is particularly true for grapes, and many growers and packers take advantage of it. It has been asserted that before a system of overnight cooling was adopted it was impossible to ship peaches and plums in sound condition from some of the interior points of the San Joaquin valley of California.

During the last eight years the Bureau of Plant Industry has conducted investigations of different methods of quickly cooling fruits before shipping. This practice, which has for its object reducing the temperature as quickly as possible, has been designated "precooling." Under this system the ice of the refrigerator car is not expected to cool the fruit, but only to keep it cool during the trip across the continent.

Precooling is usually done by mechanical means after the fruit is packed, either in a warehouse or a cold-storage plant before loading on the cars or after loading by forcing large volumes of very cold air through the cars, thus reducing the temperature of the fruit much more rapidly than can be done with ice alone. Precooling may also be done before packing, and when this is practicable it is comparatively easy, because there is a chance for the circulation of the air around the fruit. The disadvantage of such a system is that the packing has to be done in cool rooms to avoid the condensation of moisture on the cold fruit.

The best system of precooling, whether in cars or in warehouses, has not yet been definitely determined, although two of the great transportation companies of the Pacific coast are erecting mammoth plants to precool in the cars all the fruit shipped over their line. One great disadvantage of this system is the delay which must necessarily ensue in assembling the cars from the different districts. Much of the beneficial effect from precooling will be lost unless the work is done as soon as possible after the fruit is packed. A delay of even 12 hours during warm weather may very seriously affect the results.

Another disadvantage in car precooling is the great difficulty or impossibility of so distributing the air that every package will be reached. Under the best conditions some of the packages will be cooled very much more quickly than others, depending upon the method of applying the air.

Precooling in a warehouse or cool room consists in placing the fruit in a refrigerated room, with sufficient piping to keep

the room temperature well below the desired point until all the packages are thoroughly cooled. The packages may be so stacked that a thorough circulation is possible, resulting in greater uniformity in the cooling than is the case in the closely packed car.

One disadvantage of having the precooling done in warehouses is the expense of building and maintaining the necessary plants, and this must be borne by the shipping companies, growers' associations, or individual growers. Under this system the expense and responsibility fall on the shipper, while under the car-precooling system the transportation companies bear the burden. However, the transportation companies must require that the fruit be delivered to them in sound condition and fit for shipment, and whether the placing of the packages in proper condition for safe shipment should include the reduction to a proper and safe temperature is an open question.

The advantages of precooling in the handling of deciduous fruits are manifold. The first and most important of these is the fact that, if precooled, the fruit may be left on the trees to attain a greater degree of maturity, thus assuring a much better quality. It has been shown that the soft fruits, like plums, peaches, and apricots, may be allowed to remain until they reach a hard-ripe condition and may then be shipped long distances without deterioration. In the case of cherries and berries, precooling will enable the crop to be shipped greater distances, thus assuring wider market distribution and more satisfactory condition on arrival.

Precooling is now recognized as one of the important factors in the safe shipping and handling of highly perishable products, and its use will be extended as its advantages and application are better understood. It should never be used as a means to overcome difficulties arising from improper or rough handling. Used as a means to insure safe shipment after the grower and packer have done their share, precooling is both valuable and legitimate. Used as a means to overcome the effects of rough handling, precooling only retards decay and deterioration for a time, and the troubles develop when the fruit warms up after arrival in market.

A. V. Stubenrauch,

Expert in charge of Fruit Transportation and Storage Investigations, Bureau of Plant Industry. (1909 Year-book.)

EUROPE AS A MARKET FOR OUR APPLES AND PEARS

Henry B. Miller

American Consul at Belfast, Ireland

Great Britain is not in a general way an apple-growing country. Ireland is perhaps the best apple-producing section of the empire, but its production does not exceed over 50,000 barrels. The apples grown in Ireland are especially prized for cooking purposes and there is no doubt but that the production of cooking apples will tend to increase, but it will be many years before it will have any appreciable effect upon the market. The Department of Agriculture is endeavoring to encourage apple growing by establishing experimental orchards and giving instruction in horticulture in various districts.

The table given shows the importation of apples into Great Britain for four years, together with the countries of their origin. A review of the apple importation into Great Britain for a period of years prior to this schedule shows that for a number of years the annual importation amounted to between five and six million dollars. In 1892 the imports for some unknown reason nearly doubled and reached about $10,000,000, and since that time they have remained close to that value, varying only slightly either way, and for the last year of statistics, 1908, the total imports amounted to $10,398,500. It seems clear, therefore, that there is little likelihood of any decrease in this quantity of imports of apples into Great Britain. There is a fair prospect, under favorable conditions of industrial prosperity, of this amount being considerably increased.

The United States of America shares in this market to the extent of something over one-third, averaging for the past

four years $4,000,000 per annum. Canada is now our strongest competitor, sharing about equally with us in the amount of exports. Belgium and France are the next in trade, Australia and Tasmania following. We are not competitors with the Australian and Tasmanian apples, for they come into the markets at a different time of the year, mostly during May and June, while our apples are almost entirely fall and winter varieties.

The great bulk of apples in the markets of Great Britain are shipped in barrels, and measured by the Pacific-coast standard of quality and pack, are of a very inferior grade. The consumption of apples in Great Britain is, however, largely for cooking purposes, and on this account it consumes an enormous quantity of inferior and low-grade stock. The bulk of these apples is bought by brokers from the orchard, thrown into the barrels in an indiscriminate and careless way, and shipped without thought or care for the reputation of the business. This style and method of handling fruit, when it is met by the superior skill and care of growers and shippers of the North Pacific coast, will be very readily discovered in the trade. Scabby, wormy, scaly fruit is the rule rather than the exception in the apples shipped from the Atlantic coast of the United States.

Commanding the apple trade of Great Britain in the future depends on the quality of the apple placed in the English markets and the style of packing. The class of trade to which the growers for export can appeal, is the class that buy the best goods and pay high prices. The most serious obstacle at present standing in the way is that American fruits, as a rule, are not well packed and graded. Also the cost of transportation has been against us. With the building of the Panama canal the cost of transportation ought to be reduced, and with the education of the producer the quality and packing of fruit will be of higher grade. A little better understanding in relation to the varieties for the market in future plantings would be of great value. The taste of the British apple consumers demands a fruit filled with juice; a dry apple will never be popular there. Sufficient acid to make it a good cooker is also important.

The present cost of transporting a box of apples to the European market from the Pacific coast is 75 cents.

The great market for the apples of the Northwest in Europe cannot well begin until the completion of the Panama canal. Considerable quantities of good grade stock will find a market there from now on, at a profitable rate, and shipments ought to increase very materially every year, but the market for the Pacific-coast apples is not likely to reach into the million dollar class until the completion of the Panama canal. By that time, however, shipments ought to reach in the markets of Europe from three to six million dollars per annum, and cost of transportation should not be over 35 cents per box.

Apples are coming into the British market in January and February from the Pacific coast badly injured by freezing. This, of course, will not occur in shipments by steamer after the opening of the canal.

The following are the leading varieties of apples being imported into Great Britain, with their selling value according to the order in which they are mentioned:

Grimes Golden, Yellow Newtown Pippin, King, Northern Spy, Jonathan, Russet, Baldwin, Gano and Ben Davis.

There are many other kinds in the markets, both in barrels and boxes, but it is safe to take the above as all being standard varieties. Kings, Jonathans and the best of the Baldwins are marketed before the first of the year.

Importation of Apples into the United Kingdom

FROM	1905	1906	1907	1908
Germany	$ 19,385	$ 70,390	$ 20,890	$ 7,695
Netherlands	141,105	64,480	100,580	118,220
Belgium	121,800	126,395	176,560	475,265
France	276,440	80,585	107,240	365,420
Portugal	220,165	228,395	171,585	212,440
Spain	122,760	17,780	81,880	5,165
United States of America	4,684,340	4,342,190	4,299,000	3,649,215
Other foreign countries	1,020	1,040	1,935	1,935
Channel Islands	61,445	52,810	28,520	24,950
Australia:				
West Australia	....	300	2,920	2,295
South Australia (including north territory)	139,770	117,715	59,115	264,115
Victoria	122,175	106,990	218,005	140,555
New South Wales	1,000	1,355	3,535	6,970
Queensland	....	....	....	25
Tasmania	894,590	666,505	1,287,—	1,114,530
Canada	3,519,750	2,889,910	4,604,370	4,007,780
Other British possessions	320	535	2,400	1,440
Totals	$10,352,965	$8,767,885	$11,156,635	$10,398,515

Importation of Apples into Germany

FROM	1907 Bushels	1908 Bushels	1909 Bushels
Belgium	378,632	820,608	509,568
France	187,200	220,416	187,200
Italy	3,329,376	298,176	3,329,376
Netherlands	906,964	998,160	906,864
Austria-Hungary	2,140,656	3,005,472	2,140,656
Switzerland	1,193,136	2,986,464	1,193,136
Servia	168,576	....	168,576
United States	442,992	207,600	442,992
Australia	75,888	64,272	....
Totals	8,983,632	8,640,816	8,983,632

NOTE.—The figures for 1909 are for the first eleven months only.

The value of the importations of fresh apples and pears into Germany has been between $5,000,000 and $8,000,000 per annum for the past 10 years. The share of the United States in this trade is comparatively small, but will increase with the better methods of growing and packing, and the reduced cost of transportation.

Germany is making a creditable effort in the production of apples, and the number of apple trees planted in the empire is over 52,000,000.

German reports place the imports of pears and quinces together in the following table:

FROM	1907 Bushels	1908 Bushels	1909 Bushels
Belgium	349,300	300,950	459,600
France	208,700	....	....
Italy	173,900	181,550	278,950
Netherlands	402,100	158,100	308,300
Austria-Hungary	944,650	432,450	1,570,000
Switzerland	71,750	60,600	305,000
Totals	2,195,950	1,278,500	3,009,650

The average import price per 100 kilos (220.4 pounds) in 1907 was 14.82 marks ($3.53); in 1908, 13.13 marks ($3.12); in 1909, 17.34 marks ($4.12). The average import price in 1907 and 1908 was about 1½ cents per pound, and in 1909 nearly 2 cents per pound.

From this table it seems that the United States has no part of consequence in the pear trade.

Importation of Pears into the United Kingdom

FROM	1905	1906	1907	1908
Germany	$ 59,080	$ 117,830	$ 87,425	$ 9,390
Netherlands	138,975	89,895	199,865	64,415
Belgium	221,455	327,630	611,715	422,430
France	1,019,205	1,736,055	1,190,270	1,415,310
United States of America	471,490	437,010	132,210	470,185
Other foreign countries	6,650	4,280	11,570	5,465
Channel Islands	19,240	52,595	30,845	29,570
Cape of Good Hope	6,440	20,395	35,365	56,100
Australia	44,560	23,765	75,240	23,290
Canada	51,965	51,905	18,540	83,455
Other British possessions	25	10	10	10
Totals	$2,039,095	$2,861,370	$2,393,055	$2,579,620

Pears to the value of $2,500,000 are annually imported into Great Britain. This amount has been remarkably constant for the past five years.

France has a little over half of this trade, with Belgium usually second and the United States third. A pear satisfactory to the Christmas trade will have little opposition in the British markets, because the French and Belgian pears are difficult to keep so late, and as soon as pears begin to soften the dealers do not care to handle them. One of the finest openings for fruit is this British market for winter pears. Fruit commission houses have been paying from 2 to 3 cents each for pears in 20-pound boxes of from 40 to 50 pears each.

The following varieties are common sellers:

B. Clargeau, Beurre Hardy, Doyenne du Comice, B. de Anjou, Easter Beurre, American Duchess, Beurre D'Arenberg, Charles Ernest (this is an exceptional favorite as a winter pear), B. Magnifique, Glow Morceau (is a high-priced and popular winter pear), Josephine de Malines (is one of the best winter pears). This season the Kieffer has been a splendid seller. Small pears, such as Winter Nelis, however luscious, do not seem to answer the demands of this market.

During the latter part of February this year large consignments of Bartlett pears came to the British markets from Cape Town, South Africa, under the name of

"Bon Chrelien," also known in the street as "William pears." These pears were introduced from France to England by a man by the name of William, and therefore pass under his name here. The same pear was introduced into America by a Mr. Bartlett, and hence in the United States is known as the Bartlett pear. Thousands of boxes of these pears are consigned into the British markets now, and will continue to come until some time in May.

They come in small, single-layer boxes of 28 pears each, and sell here at $1 per box from the commission houses. This fruit comes by steamer a distance of over 6,000 miles, requiring about 20 days for the trip from Cape Town to London. Those that I have seen have been landed in fine condition. The best opportunity seems to be to produce something good for the holiday season.

The Royal Horticultural Society of Great Britain is to a large extent responsible for the development of horticulture in South Africa. They are taking great interest in the production of fruit for the British markets in the various British colonies, and the results of their efforts are showing good returns in many cases.

Importations of Apples and Pears into France

FROM	1907 Bushels	1908 Bushels
Germany	5,930	....
Austria-Hungary	10,080	....
Turkey	2,275	....
United States	82,875	19,765
Canada	1,245	790
Other countries	2,340	695
Totals	103,740	21,250

I have been able to get very little information concerning the French markets, but from the above table you will observe that so far as imported apples and pears are concerned, the market for foreign stock is not very great. My advices indicate that no pears are imported into France from the United States, and those that are imported are of two varieties, "Amorelle" and "Blanche."

Horticulture in France is a most prospering industry, and besides growing fruits for their own markets they are extensive exporters to various European districts. In October, 1909, a Technical Board of Horticulture was created and attached to the Ministry of Agriculture. The purpose of the board is to promote horticultural development in France.

In the European markets, especially in pears and the more delicate fruits, France has a great advantage over the United States, and in arranging for marketing our fruits in this part of the world care should be taken to avoid such plantings for this trade as are likely to be ruinous against the French product. A special study should be made of the French productions in order to get a thorough understanding of this phase of the subject. It is clear that any apple-growing section, in order to make a permanent success, must establish and maintain a standard of fruit and pack that will fix its reputation high and substantial in the markets of the world.

A single ship from New York has just brought into Liverpool over 30,000 bushels of apples, and this is only one of several ships clearing every week carrying fruit during the season. The British markets consume between 10 and 12 million dollars worth of imported apples each year, with an increasing tendency.

The parliament of Ontario, Canada, a year ago passed an act providing for the

grading, marking and inspection of apples, with penalty of a fine for falsely marked packages. This has had a good effect in improving the grading, and has brought better returns in cash. The formation of an association of Ontario fruit growers and the establishment of general packing houses, with uniform packing guaranteed by the association, has had a still better effect, and the association products bring the highest price in the market.

THE REDUCTION OF WASTE IN MARKETING

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Of the items entering into the cost of marketing fresh fruits and vegetables, possibly one of the greatest is the loss due to waste. Two important causes of this waste are slowness of delivery to the buyer and the glutting of markets. Delay in transportation may cause the produce to decay or wilt, so that it may bring small, if any, returns, or, even if it arrives in good condition, it may be too late to be sold at good prices. A loss in selling price may be caused also by a faulty distribution of consignments, whereby some markets are overstocked, while there is a scarcity at others. These two causes of waste are being overcome, to some degree at least, by improved methods of distribution, as used by shippers, and by better transportation service.

It is the purpose of this article to show the working of two general plans, whose extended use dates back scarcely 10 or 15 years. One plan is used by shippers to distribute consignments among cities and towns in such manner as to avoid a glut; the other scheme is employed by transportation companies to move perishable freight quickly, and at the same time to be ready to change its destination on short notice, even when it is on the way to market.

The Carload as a Unit
A Saving in Money and Time

In farming on a large scale, the unit of quantity for a shipment is regularly a carload. The advantage of a car lot over a smaller quantity is so great that the smaller shipment competes at a disadvantage, except in near-by markets. Not only are the freight rates for carloads lower, but the time of transit is shorter and the risk of injuring the produce in transit is less. A car lot may be sent to any one of a large number of cities and towns, while the smaller shipment is limited, by the higher freight rates and by delays in transit, to fewer markets.

Since car lot shipments form such a large proportion of the total supply, conditions which affect their marketing influence also the marketing of the smaller lots of highly perishable fruits and vegetables. Home-grown produce is more apt to bring good prices in the neighboring city or town under conditions which tend to reduce the danger of an oversupply from distant regions. Hence, changes affecting the movement of carloads, as discussed in this article, affect the entire truck-growing industry.

There are a number of plans by which small shippers join in making up a carload. This is regularly done by farmers' co-operative associations. Country buyers also gather produce from various farmers, arranging their purchases so as to have carloads for shipment. Of the other plans for combining smaller lots in carloads, two of the more noteworthy are the local "pick-up" service of some railroads and the system employed by some forwarding agents.

Combining Small Lots

There are forwarding agents whose business it is to collect small consignments at various points in the Mississippi Valley and to ship them to market. The forwarding agent gathers enough produce to make a full carload at a given station, consigns it to himself at the destination, and delivers the contents to various consignees. By this system a small shipment by a producer is carried as prompt-

ly as a full carload. The territory served by these forwarders includes stations in Louisiana, Mississippi, Tennessee, Illinois, Michigan, and a few points in Indiana. The forwarder, being responsible to the shippers, makes it his business to check the contents of the car as they are taken out, to note their condition, and to report to the shipper any irregularities as to the condition or number of packages. The car manifest of the forwarder shows the names of the shippers and of the consignees, the number and contents of packages. The manifests that happened to be in the office of one of these forwarders one day in July, 1911, and which were apparently not unusual, contained each a long list of separate items; the manifest for one car contained a list of packages for no less than 32 different consignees.

A so-called "pick-up" system is conducted by different railroads for collecting less-than-carload lots from various stations and combining them at transfer points into full carloads. Small consignments are collected from a number of stations and brought to a given point to be combined into carloads. Among the typical transfer points for combining small shipments into carloads are Canton, Miss., and Norfolk, Va.

The growth of freight and express service on interurban trolley lines has made it easier to market small shipments of perishable fruits and vegetables promptly. The interurban electric lines gather up small shipments and concentrate them at forwarding points. Large quantities of fruits and vegetables are thus handled from points in Southwestern Michigan. The produce is collected from such points as Berrien Springs, Eau Claire, and Millburg, and transferred to boats at St. Joseph and Benton Harbor to be forwarded thence to Chicago. This service is prompt; fruit collected one day is on the Chicago market early next morning. A similar traffic is carried through Norfolk, where railroad freight from truck-growing regions is transferred to coastwise steamers for New York and the North.

Freight Service

General Improvements in Railroad Facilities

Progress in methods of hauling perishable fruits and vegetables is part of a general betterment of railroad service. Improved roadway, heavier rails, larger cars, and more powerful engines, together with more efficient handling of the traffic, all help toward quicker and cheaper marketing of produce. Some of the features of these improvements are shown in statistics compiled by the Interstate Commerce Commission.

Within the past 20 years the quantity of freight moved has increased many fold. During the year ending June 30, 1889, the freight traffic on railroads of the United States equaled about 69,000,000,000 ton-miles; 20 years later this freight amounted to 219,000,000,000 ton-miles. This increased traffic is accounted for not only by an extension of railroads, but by an increase in the amount carried per mile. The density of the traffic in 1909 was more than double that in 1899. To move this freight the size of the trains was increased as well as the number of locomotives. In 1889 there was an average of 10 and in 1909 between 14 and 15 locomotives in the freight service for every 100 miles of railroad, while the average number of tons carried in a freight train more than doubled.

Tracing a Car's Movements

The freight carried on many railroads is divided into classes, based upon the kind of service rendered. The highest class of goods is given the quickest and most regular service. A second class of goods, and even a third or a fourth, may also be moved in trains having regular times for arrival and departure, but which are slower than the "manifest," "red ball," or "vegetable express" trains. These classes are distinct from the classes upon which freight rates are based.

Fresh fruits and vegetables are usually included in the list of commodities which are given this best service. Trains carrying these perishable products are run at greater rates of speed and with greater

regularity than are ordinary freight trains. Delays are reduced to a minimum, and especial care is taken to have the cars carrying these fruits and vegetables move promptly along the way. Where the traffic justifies it, entire trains are made up of such produce.

One feature of this service is the telegraphic report which is made of each car as it passes each reporting station on its route. These "passing" reports, however, are made on some railroads for lower classes of freight also.

Some of the principal parts of this system were in use before 1885 on at least one railroad. Cars were reported by telegraph on passing certain points, and their movement was recorded in the central office, not only in writing but by means of pegs. Each car was represented by a peg bearing the symbol of the car and inserted in a block which represented the train. The route over which the cars moved was represented by a board on which vertical lines and spaces indicated the various stations from which "passing" reports were made. When a train was reported to have passed a station, the block representing the train was moved past the place on the board that represented the station. The telegraphic report mentioned each car in the train; cars not so mentioned were accounted for, with the reason for delay, or were the subject of prompt inquiry from the central office. This system is now in use on a number of railroads. The information shown on the board is kept also in written form, and, on some railroads, it is summarized in circulars, issued daily. The "board" is convenient but not an essential part of this sytem. Some railroads do not use a board at all; they keep all their "passing" records on paper.

To facilitate telegraphing in some of these "passing-report" systems, each car may be given a symbol after the train is made up. The symbol consists of a letter or group of letters, which indicate the station of origin, and a number to designate the car. The car is known by this symbol until it reaches its destination and the contents are delivered.

Rates of Speed

The average rate of speed over long distances for carloads of perishable freight depends largely upon the character of the roadbed and the number of transfers from one railroad to another. From Los Angeles to Chicago and from Jacksonville, Fla., to Chicago, the rate of speed averages about 13 miles an hour, including all stops. One train was scheduled to run from Los Angeles to Chicago in 173 hours and 25 minutes, the average rate being 13.1 miles per hour. A vegetable express run from Jacksonville to Chicago over three or four different railroads covers about 1,140 miles in 89½ hours, the average rate being 12.7 miles per hour. By another route the trip from Jacksonville to Chicago is reported to be made in as short a time as 84 hours. Over some routes which do not traverse mountains the average rate, including stops, is about 16 miles per hour for long distances. A certain train from New Orleans to Chicago covers 930 miles in 57 hours and 20 minutes, the average rate being 16.2 miles per hour; and on the Atlantic coast a train carrying Florida produce northward runs from Tampa, Fla., to Richmond, Va., in 54 hours and 15 minutes, making an average of 15.8 miles per hour. After a train is once made up and does not have to stop so often to receive new cars the rate of speed is naturally much higher. Between Memphis and Chicago the average rate of speed for a certain train is 18 miles per hour, while the rate from New Orleans to Memphis is 14 to 15 miles per hour. From Tampa to New York the rate for the distance south of Potomac Yard, Virginia, is about 16, while the distance between Potomac Yard and New York is covered at an average rate of more than 18 miles per hour.

At the rates of speed mentioned in the preceding paragraph, a train would run from 312 to 432 miles in 24 hours. The time taken to move cars from Potomac Yard, Virginia, just south of Washington, D. C., to New York, is about 12¾ hours; to Boston from Potomac Yard, 36½ to 40 hours; and to Montreal, 46¾ hours. These figures include the time required

for icing and for transferring the cars from one road to another. From Miami, Fla., to New York the time is approximately 96 hours, and from Miami to Chicago about 108 hours. It is thus possible for fruit and vegetables grown in regions as far away as Southern Florida to be delivered to consumers in Chicago or New York within five or six days from the time of gathering.

Regularity of Service

While these fruit and vegetable trains, as any others, may be late sometimes, nevertheless their regularity is such that transactions are reported to be made often, if not usually, with the expectation that the produce involved will be delivered at about a certain time on a certain day. For instance, a car of vegetables from a South Atlantic shipping point may be bought by a dealer, who expects the car to reach Jersey City on a Friday night in time to be ferried across North river to a wholesale market in New York, which opens at 1 a. m. Should this car be delayed several hours the vegetables would miss the Saturday morning market and might be delayed two days in reaching the retail merchants.

Two instances of delays will serve as illustrations. A merchant in Philadelphia mentioned a consignment of strawberries which reached that city from Florida six days late, and a Chicago dealer complained, about the same time, of losing $500 on a car of strawberries that reached him too late to take advantage of a good market. Delays like these, it is believed, are by no means as frequent under present conditions of freight service as in earlier times.

Extension of Demand and Supply

Number of Markets

Inquiries were made by the Bureau of Statistics of this department in August, 1911, as to the different kinds of highly perishable fruits and vegetables which were received in car lots for local use in cities having a population of not less than 25,000. Of the 103 cities for which reports were made, peaches were sold by the carload in at least 87; watermelons, in 86; cantaloupes, 77; bananas, 72; strawberries, 71; tomatoes, 66; oranges, 65; grapes, 53; lemons, 39; pears, 32; pineapples, 28; plums, 24; celery, 18; cherries, 13; cucumbers, 11; green beans, 11; apricots, 11; and each of about 25 other commodities of this class were reported to have car-lot markets in from 1 to 10 different cities. The reports on which these figures are based are probably incomplete to a greater or less degree; some products are no doubt omitted which should have been included. If it had been possible to secure complete lists of all such products for each of these cities, the figures just given would probably have been larger. As they stand, these incomplete figures show a wide range of markets where car-lot shipments of fresh fruits and vegetables may be sold. The producer has many good outlets for his crops; if market conditions in one place are not satisfactory, there may be other places where fair prices may be obtained. The cities which absorb these products by the carload include many whose population is less than 50,000. Of the 87 car-lot markets for peaches in which returns were made in this investigation, 30 were cities of less than 50,000 inhabitants; 23 of these smaller cities took cantaloupes by the carload, 19 received grapes and strawberries, and 17 received tomatoes. Other products of this class also found sale in car lots among these smaller cities.

The number of car-lot markets for fruits and vegetables has increased greatly during the past decade. This is indicated by reports made by railroad freight agents and produce dealers in various cities as to the year in which the first carloads of certain products were received for local use. The products for which the fullest reports were made were peaches, strawberries, cantaloupes, tomatoes, and grapes. Of the 42 markets which reported the year when the first carload of peaches was received for local use, 13 had become car-lot markets within the past decade; the markets whose first carload sale of strawberries was made since 1900 numbered

15 out of a total of 35 reported; for cantaloupes, 21 out of 40; tomatoes, 19 out of 32; and for grapes the car-lot markets, which were opened within the past 10 years, numbered 13 out of a total of 24 for which reports were received. Taking account of the minor products of this trade, as well as the five leading ones just mentioned, the average rate of increase in the number of car-lot markets for highly perishable fruits and vegetables was over 40 per cent in the decade beginning with 1901 as compared with the ten years just before.

Wide Range of Sources of Supply

Many of the large markets, and smaller ones also, receive their fresh fruits and vegetables from regions which are far apart. The examples given here refer to large cities, but illustrate conditions at many others. The sources of supply of a given product in a market like Chicago or New York may often be traced by the price quotations in those markets for perishable fruits and vegetables. It is common in those, and in other markets as well, to mention the state or locality where the products quoted were produced. By tabulating quotations of different commodities it is thus easy to learn also the time when the produce from a given locality is on a given market. For the season of 1910 the quotations of Florida tomatoes appeared in the produce reports at Chicago, New York, and Kansas City early in the winter and continued to about the middle of June, when Texas tomatoes began to appear. These were followed, in the Chicago market, by shipments from Mississippi, and about the first week of July the produce of more northern fields. Among the states which contributed tomatoes to the Chicago trade in 1910, besides Florida, Mississippi, and Texas, were California, Tennessee, Missouri, and, of course, Illinois. New York's supply came also from a large number of states, among which were California, Florida, Texas, Mississippi, Tennessee, Virginia, North Carolina, South Carolina, New Jersey, Maryland, and Delaware, while some were imported from Cuba.

The supplies of peaches, strawberries, cantaloupes, string beans, and other products were also drawn from a wide range of territory. In 1910 there were at the same time quoted in New York City strawberries from Florida, Louisiana, Virginia, Maryland, and the Carolinas, and while some of these southern berries were still in the market, supplies came in from New Jersey and New York. The cantaloupes used in New York in the latter part of June and the first of July, 1910, were coming from Florida, Georgia, and the Carolinas, and also from Arizona and the Imperial Valley of California. A few weeks later melons from Maryland, Delaware, Virginia, and New Jersey met, on the same market, those from New Mexico, Nevada, and Colorado.

In April and May of the same year the asparagus sold in New York City was grown some near the Pacific coast and some in the regions along the Atlantic. Peaches from Texas and other Western states were included with those from Eastern states in the receipts at New York.

The sources of supply in a given market are governed to some degree by changing conditions of trade. Under some conditions it would be profitable for the produce of a certain state to compete in a given city with produce from states which are nearer that market, but whose own crops are short. For instance, when the Arkansas peach crop is small, Georgia may be shipping to points as far west as Denver, while if the Arkansas yield is large, Georgia peaches might get into few markets west of Chicago.

Systematic Distribution
Finding a Market

A personal acquaintance between buyer and seller is an important factor in successful marketing. A truck gardener who visits the different markets occasionally and meets dealers there is in a much better position to sell his produce than if he consigned it to strangers; and, further, the co-operative association having representatives in important markets throughout the season may be expected to

sell on much better terms than the individual shipper who visits the market only occasionally. Likewise, among merchants, the man who keeps in touch with other markets knows much better how to distribute his excess supply, or send orders to meet the demands of his customers, than the dealer whose acquaintance is not so large.

The shipper or his representative should know also the characteristics of the various markets which may take his produce. For instance, a certain town will be able to use one full carload of cherries, while for another town it would be better to make up a mixed car consisting of cherries and two or three other kinds of fruit; or, again, in one city, as New York, it is important for certain produce to be delivered in time for the night market, while at Chicago the shipments will be on time for the regular market if they reach the railroad terminals or the steamboat wharves before daybreak.

Reports of market conditions are given regularly and with varying degrees of accuracy in daily newspapers, trade and agricultural journals, and in circulars issued by dealers and organizations. In addition to these sources of information, some shippers and dealers receive special reports, by mail or wire, from different markets.

Control of Produce in Transit

Information as to the location of a given car in transit may usually be obtained from the railroad company which is hauling the car. But some large shippers have a system of their own by which they trace the movement of cars in transit, in order to distribute them among the different markets to the best advantage. One organization in California adopted this system of distributing shipments: When a member shipped a car of produce, he turned the bill of lading over to the manager of the organzation and allowed him to direct the movement of the car to market. The object of having one central authority select the markets was to prevent sending an oversupply to any one place. On receiving the bill of lading, a record of the car was made on a card in the office of the organization and the card filed in its proper place in a drawer. This drawer was divided into several rows of compartments, opening upward; each row had 31 compartments, and there was one row for each principal market in the United States. The 31 compartments represented each one day of a month. When a card was filed its location was determined by the destination named in the bill of lading and by the day of the month on which the consignment was due at the destination. For instance, a carload of cherries shipped to New York from a point in the Sacramento valley on May 27 would be represented by a card filed in the New York row of the drawer and in the compartment numbered 7, if the consignment would be due in New York on June 7. The arrangement of these cards showed at a glance the intended distribution of this association's shipments among the different markets, and when too many consignments of a given kind of fruit were on the way to a given market the grouping together of several cards in one box served as a warning that the destination of one or more cars should be changed. This drawer showed only such fruit as was shipped by this association. News of other shipments and of their probable time of arrival at destination was secured, to some extent, by the association. When it became known that a certain market was about to receive an oversupply of a given fruit, one or more of the shippers who had consigned to that market would be notified by the association manager, so that they might select another city to which to divert their consignments. In case they should refuse to make such a selection the rules of the association gave the manager the right to divert the shipments himself.

The movement of a car in transit was traced by the association by a system similar to that used by some railroads. Each car shipped east by the association was reported by telegraph as it passed certain points along the way.

In a similar way other large shippers keep in close touch with the progress of a car on its way to market, at the same time keeping informed as to the prices and relative supplies in different cities and towns.

For produce moving from the South northward many of the principal points of diversion are along the Ohio and Potomac rivers, but the route of a car may be changed at any one of a large number of railroad junction points. Cairo, Louisville, Cincinnati, and Potomac Yard (near Washington) are important points from which these shipments are distributed among various destinations.

Between Eastern markets and producing regions in the far West and Southwest the chief points of diversion include Minnesota Transfer (between St. Paul and Minneapolis), Council Bluffs, Chicago, and St. Louis. Over one route from Central California to the East the principal points from which one leading shippers' association receives "passing" reports are Roseville and Truckee in California, Ogden, Council Bluffs and Chicago. A Cincinnati firm may receive notice of a Florida shipment when the car passes Jacksonville, Atlanta, and Chattanooga, and another notice just before the arrival at Cincinnati. On peaches shipped by this fast-freight service to Northeastern markets from Tampa, a car's progress over a certain route is reported from Jacksonville, Fla.; Savannah, Ga.; Columbia, S. C.; Hamlet and Raleigh, N. C.; Richmond and Potomac Yard, Va.

The service of diversion includes not only changing the destination of a car in transit, but forwarding it to a destination beyond the one originally named. For instance, a car shipped to Cincinnati may be forwarded under certain conditions to Indianapolis for unloading; or, it is reported, a car consigned to a given town may be partly unloaded there and the remainder of the consignment sent on to another town. This, however, costs more in freight than would a direct shipment of a full carload to one market.

How a Car Is Diverted

Conditions on one route will illustrate how the system of reporting car movements may be used by a patron of the railroad. Suppose a dealer in Chicago, on a Thursday morning, wishes to know the location of a carload of tomatoes which were shipped to him the morning before from Crystal Springs, Miss. He makes the request of the railroad company's agent in Chicago, giving the initial and number of the car and the date and place of shipment. On consulting the "passing" reports it is found that this car, known in transit by the symbol "CS-4," passed Fulton, Ky., at 6 a. m. that day (Thursday) and would be due at Cairo, Ill., at 8:30 a. m., or, let it be assumed, about an hour after the time the dealer made inquiry. It would be due in Chicago Friday at 4:50 a. m. With this information the dealer knows that, if he desires to divert the car, he may select one of a number of markets located north of the Ohio river. He knows that there is a large movement of tomatoes toward Chicago and believes that the prices on Friday will be better in some other places than in Chicago on the day his produce is due on the market. He has already received news from some points. An associate in St. Louis may have telegraphed the evening before that the supply already in that market, together with what was due to arrive on Thursday, would be about as much as could be sold at fair prices; that, if more was received, prices would probably be low. On the other hand, a report from Indianapolis may indicate good prices for Friday morning, better ones than are promised in Chicago for that day; so the Chicago dealer orders the car to be diverted to Indianapolis. He may wait until 3 p. m. Thursday before reaching this decision, so that he may hear from other markets. Meanwhile the car has been moving northward. The order for diversion is sent by the superintendent of transportation to the proper official at Effingham, Ill., where the car is due to arrive about 5:45 p. m., and where transfers are regularly

made for Indianapolis. It reaches that city early Friday morning, about the time it would have reached Chicago had there been no diversion.

Distributing a Car Lot

Cities and towns which do not require a full carload of a given product are often supplied from neighboring car-lot markets. Small lots of perishable goods may be forwarded in refrigerator cars devoted to local service. For small consignments of fruit and vegetables intended for neighboring towns refrigerator cars are run on regular schedules from Chicago and other large cities, and each car is assigned its own route. The service on one railroad will illustrate this traffic. This railroad sends out from Chicago, every night except Sunday night, 11 trains hauling such cars. One of these trains, leaving Chicago at 9:45 p. m., takes cars for 14 different routes; three of these cars are run only two days of each week, five of the cars are run on three days of the week, and six cars are run on six days. A car may be transferred from one train to another, making one, two, or more transfers before it reaches its destination. From this train cars are transferred at various points in Iowa; one car is taken off at Cedar Rapids, another at Marshalltown, still another at Ames, a fourth at Tama, while at Eagle Grove three cars are taken off and given to three different trains. At Belle Plaine two more trains are each given a car, and at Mason City another transfer of a car is made.

Interurban electric lines and steamboats help to distribute small lots of fresh fruit and vegetables from car-lot markets. In addition to the traffic on steam railroads, large quantities of this kind of produce are thus distributed from Cincinnati by trolley lines and river boats, while lake steamers assist in this work at Chicago.

Shipments of less-than-carload lots of this highly perishable produce are apt to be more frequent in times of high prices. Under some conditions less-than-carload lots may be shipped all the way from Chicago to St. Paul, or even to Omaha. But, as has been said in the first part of this article, the regular way of transporting these fresh fruits and vegetables is by carload lots, shipments in smaller quantities, except for short distances, being chiefly to markets where a larger quantity could not be sold.

Conclusion

The extension of better ways of distributing fresh fruits and vegetables among the various markets and the improvement in transportation service have done much to reduce the waste in marketing, but there is still room for improvement. Sometimes a crop in a given region will be too large to be marketed promptly. There may be too few cars to carry the produce, and it spoils while awaiting shipment; or it may be loaded in cars and started on its way, but the increased number of cars may be more than the railroad can handle promptly, and a congestion of traffic may cause a delay of several days on the way. Or, even with quick and adequate freight service, the produce may yet fail to be well marketed. It is not always practicable for shippers to determine beforehand the approximate supply which a given city or town is about to receive, or to judge how much can be sold there at fair prices, and an error in the shippers' judgment may result in glutting a market.

But in spite of occasional losses due to car shortages, freight blockades, and overstocked markets it is a widespread opinion among shippers that there are fewer losses on fresh fruits and vegetables now than there were 10 or 15 years ago; and the tendency of the present time is to reduce still further the waste in marketing.

Year-book, 1911.

MARKETING CANTALOUPES. See under *Cantaloup Culture*.

Cost of Hauling Products to Shipping Points

Table 1—Average Cost of Hauling Products from Farms to Shipping Points—Totals for States Represented

PRODUCT HAULED	Number of counties reporting	Average					
		Miles to shipping point	Days for round trip	Pounds in one load	Cost per load	Cost per 100 pounds	Cost per ton per mile
Apples	114	9.6	0.9	2,300	$2.79	$0.12	$0.25
Barley	226	8.8	.7	3,970	2.67	.07	.16
Beans	22	9.0	.8	3,172	2.75	.09	.20
Buckwheat	8	8.2	.8	2,438	2.90	.11	.27
Corn	981	7.4	.6	2,696	1.78	.07	.19
Cotton	555	11.8	1.0	1,702	2.76	.16	.27
Cottonseed	110	10.7	.9	1,654	2.42	.15	.28
Flaxseed	51	10.4	.7	3,409	2.70	.08	.15
Fruit (other than apples)	99	11.6	1.1	2,181	3.53	.16	.28
Hay	761	8 3	.7	2,786	2.32	.08	.19
Hemp a	7	5.2	.7	3,393	2.10	.06	.23
Hogs (live)	316	7.9	.7	b 1,941	2.00	b .10	b .25
Hops	14	11.7	1.0	3,665	3.89	.11	.19
Oats	798	7.3	.6	2,772	1.82	.07	.19
Peanuts	19	8.1	.6	1,363	1.67	.12	.30
Potatoes	569	8.2	.7	2,679	2.34	.09	.22
Rice	18	7.5	.8	2,407	2.70	.11	.29
Rye	78	8.4	.7	2,625	2.23	.08	.19
Timothy seed c	5	8.0	.8	2,410	1.92	.08	.20
Tobacco	113	9.8	.8	2,248	2.28	.10	.20
Vegetables (other than potatoes)	152	9.8	.9	1,852	2.84	.15	.31
Wheat	1,051	9.4	.8	3,323	2.86	.09	.19
Wool	41	39.8	5.6	4,869	21.39	.44	.22

a Kentucky only. b Average for six states only. c Iowa only.

Apples

Apples were reported as a surplus crop so generally by the correspondents in this investigation that a fairly good basis is afforded for finding average conditions of hauling this fruit from farms in the United States. Owing to the small number of returns from some states, the averages for the geographic divisions and for the United States in Table 2 should be used in comparison when the figures for a single state are considered.

The high cost per 100 pounds for hauling apples from farms in the South-Central division is due largely to the small loads taken, and in the Western division the long time for the average round trip makes the cost per 100 pounds twice the average for the North and South Atlantic and North-Central divisions.

It is to be noted in connection with this product that it is the practice in some sections for the farmers to sell their apples on the trees, the buyer to do all the picking and hauling. This, however, does not invalidate the figures as given in Table 2.

Table 2—Average Cost of Hauling Apples from Farms to Shipping Points

	Number of counties reporting	Average				
		Miles to shipping point	Days for round trip	Pounds in one load	Cost per load	Cost per 100 pounds
Maine	5	8.8	1.3	2,180	$4.74	$0.22
New Hampshire	5	6.2	.5	2,630	2.02	.08
Vermont	1	7.1	.7	3,000	2 62	.09
Massachusetts	2	9.2	.6	3,250	2 63	.08
Connecticut	1	10.6	.7	2,000	2.80	.14
New York	15	7.4	.6	2,523	2.15	.09
New Jersey	3	7.1	.7	2,667	2.51	.09
Pennsylvania	8	8.2	.8	2,362	2.73	.12
Virginia	7	10.9	1.0	2,750	2.88	.10
West Virginia	11	10.0	1.1	2,332	4.00	.17
Ohio	5	7.0	.7	2,170	2.14	.10
Indiana	3	9.7	1.2	2,283	4.20	.18
Illinois	6	5.8	.5	2,367	1.25	.05
Michigan	4	9.1	.7	2,538	2.06	.08
Missouri	13	10.5	1.0	2,108	2.56	.12
Kentucky	4	11.6	.8	1,600	2.20	.14
Tennessee	8	11.2	1.0	1,556	2.62	.17
Arkansas	6	19.2	2.0	1,700	4.76	.28
Oregon	3	11 8	1 9	2,583	6 02	.23
California	4	15.6	1 7	4,500	10.40	23
Geographic divisions:						
North Atlantic	40	7.9	.7	2,490	2.53	.10
South Atlantic	18	10.5	1 0	2,584	3.18	.12
North Central	31	8.5	.8	2,267	2 26	.10
South Central	18	13.8	1 2	1,617	3.11	19
Western	7	13.7	1 8	3,558	8.36	.23
States represented	114	9.6	9	2,300	2.79	.12

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